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A TWO-STATE MODEL OF SIMPLE REACTION TIME

Yasuharu Okamoto

A TWO-STATE MODEL
OF
SIMPLE REACTION TIME

by
YASU HARU OKAMOTO

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of the requirements for the degree of
Doctor of Philosophy in
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CHAPTER I

INTRODUCTION

When a stimulus is presented, the subject responds to it with some delay. This delay is called a reaction time(abbreviated as RT). RTs are classified into two types, simple RTs and choice RTs. When the subject responds to one of possible stimuli in one of more than two ways according to the stimulus presented, the RTs are called choice RTs. If there is only one stimulus and only one type of response is required, the RTs are called simple RTs. The interval from the start of the trial to the presentation of the stimulus is called foreperiod(abbreviated as FP).

In this article, a new model of simple reaction time is proposed. To appreciate the necessity of a new model, it is useful to review models not only for simple RT, but also for choice RT. First, let us review literatures on models for choice RT.

MODELS FOR CHOICE REACTION TIME

A. Choice Reaction Time and The Number of Stimuli.

The following empirical relations between choice RT and the number of stimuli are well known(cf.,Welford(1960,1980)),

$$\overline{RT} = K \cdot \log(n+1) \quad (1-1)$$

and

$$\overline{RT} = a + b \cdot \log n \quad (1-2)$$

where \overline{RT} and n are the mean choice reaction time and the number of stimuli, respectively. Welford(1960,1980) explained that eqs.(1-1) and (1-2) were proposed by Hick(Hick(1952), cited in Welford(1960,1980)) and Hyman(1953), respectively. If the event that no signal is presented is conceived of as one of possible signals, eq.(1-1) means that mean RT is proportional to the uncertainty of choice situation. As to eq.(1-2), when we set $n=1$, $\overline{RT}=a+b \cdot \log n = a$. That is, a is the mean simple reaction time. $b \cdot \log n$ represents the increase over the simple RT due to the need for identification and choice. x bits of uncertainty means that we can identify the specific event by x steps of dichotomization process. Welford(1960) explained that Hick(1952) examined a serial dichotomous classification model.

According to Smith(1977,1980), low stimulus intensities should give a better fit against $\log n$ (eq.(1-2)), while high intensities should be better fitted against $\log(n+1)$ (eq.(1-1)) (cf. the next section).

B. Stimulus-Response Compatibility.

Smith(1977,1980) proposed the model which incorporated stimulus-response compatibility.

The onset of the stimulus, j , induces the following excitations.

$$e(j) = q + \frac{u}{N}$$

$$e(i) = \frac{u}{N} \quad i \neq j.$$

These stimulus-excitations, $e(i)$'s, are transformed into response excitations, $\rho(i)$. At cycle s of this transformation, the increment in $\rho(i)$ is $\frac{e(i)}{N}$, and the time required for this cycle is $\frac{\sum \alpha(i) \cdot e(i)}{S}$. $\alpha(i)$ is the parameter which represents the stimulus-response compatibility for stimulus, i . Let $\delta(m)$ be the response m 's criterion, and x be the cycle time at which

$\rho(m)$ reaches $\delta(m)$, then,

$$\rho(m) = \int_1^x \frac{e(j)}{N} ds = \frac{e(j)}{N} (x-1)$$

Therefore

$$\chi = \frac{\delta(m) \cdot N}{e(j)} + 1 \quad (1-3)$$

The mean reaction time of the response m to the stimulus j,

RT(j), is the sum of the integral of the x cycle duration,

$\int_1^x \frac{\sum \alpha(i) \cdot e(i)}{s} ds$, and any non-processing delays, a.

That is,

$$\begin{aligned} RT(j) &= a + \int_1^x \frac{\sum \alpha(i) \cdot e(i)}{s} ds \\ &= a + (\sum \alpha(i) \cdot e(i)) \cdot \log \chi \\ &= a + (\sum \alpha(i) \cdot e(i)) \cdot \log \left(\frac{\delta(m) \cdot N}{e(j)} + 1 \right) \quad (\text{by eq. (1-3)}) \\ &= A + B \cdot \log \left(N + \frac{e(j)}{\delta(m)} \right) \quad (1-4) \end{aligned}$$

where

$$A = a + (\sum \alpha(i) \cdot e(i)) \cdot \log \frac{\delta(m)}{e(j)}$$

and

$$B = \sum \alpha(i) \cdot e(i)$$

Eq.(1-4) includes eqs.(1-1) and (1-2) as special versions

for $\frac{e(j)}{\delta(m)} = 1$ or 0, respectively.

C. Laming(1966)'s Interpretation.

Laming(1966) used the following approximation

$$\log(n+1) = \sum_{r=1}^{n+1} \frac{1}{r}$$

and generalized eq.(1-1) as follows,

$$RT = a + b \cdot \sum_{r=1}^n \frac{1}{r+k} \quad (1-5)$$

Laming(1966) proposed two models, which predicted that the mean RT follows eq.(1-5).

The first model is extended version of the model proposed by Christie and Luce(Christie and Luce(1956), cited in Laming(1966)).

According to this type of model, the reaction time, t_n , to one of n equiprobable signals is determined by the longest of n elementary decision processes. Let $F(t)$ be the distribution function of this elementary decision latency, then

$$RT = E(t_n) = \int_0^{\infty} t \cdot d(F(t)^n) \quad (1-6)$$

Laming(1966) solved eq.(1-6) with respect to $F(t)$ in order that RT satisfies eq.(1-5). Let $F(t)=y$ and $t=\phi(y)$, then the solution is given by the following equation;

$$\phi(y) = \int \frac{b \cdot y^k}{1-y} \cdot dy + C$$

For $k=0$,

$$F(t) = 1 - e^{-\lambda(t-a)}$$

This is Christie and Luce(1956)'s version.

The second model proposed by Laming(1966) is an analogy to an epidemic model. With the assumption that the rate of interactions involving a given individual is constant λ , and independent of the size of the group, i.e., the number of equiprobable stimuli, he derived the following equation;

$$RT = \frac{2 \cdot (n-1)}{n \lambda} \cdot \sum_{r=1}^{n-1} \frac{1}{r}$$

D. Fast Guess Model.

In the fast guess model(Ollman(1966), Yellott(1967,1971)), there are two types of responses, guess responses and stimulus controlled responses. On any trial, the subject makes either a guess response with probability $1-q$, or a stimulus controlled response with probability q . When the subject guesses, he makes response A_i ($i=1,2$) with bias probability b_i regardless of which stimulus (S_1 or S_2) was presented. When the subject makes a stimulus controlled response, the response is correct with probability $a > .5$.

From these assumptions, Yellott(1971) derived the following equation;

$$\frac{p_c \cdot M_c - p_e \cdot M_e}{p_c - p_e} = \text{constant.} \quad (1-7)$$

where p_c and p_e are the probabilities of correct and error responses, respectively, and M_c and M_e are the mean reaction times of correct and error responses, respectively. Eq.(1-7) was supported by the experimental results reported in Ollman(1966) and Yellott(1967,1971).

Yellott(1971) proposed a deadline model, which does not always predict the constancy of the left side of eq.(1-7). The deadline model assumes that on every trial, information about the identity of the choice stimulus takes the form of a single quantum which arrives \underline{S} msec after stimulus onset. \underline{S} has the distribution function $S(t)$ and density function $s(t)$. If the subject waits until the arrival of the information quantum, and then responds, his response is correct with probability one. On each trial, however, the subject presets a deadline \underline{D} . If the information quantum has not arrived \underline{D} msec after stimulus onset, the subject guesses with some bias probabilities b_1 and b_2 for responses r_1 and r_2 . \underline{D} has the distribution function $D(t)$

and density function $d(t)$.

From these assumptions, Yellott(1971) derived the following equation;

$$\frac{p_c \cdot M_c - p_e \cdot M_e}{p_c - p_e} = \frac{\int_0^{\infty} t \cdot s(t) \cdot (1 - D(t)) \cdot dt}{\int_0^{\infty} s(t) \cdot (1 - D(t)) \cdot dt} \quad (1-8)$$

The right side of eq.(1-8) is not in general invariant under arbitrary transformations of $D(x)$. But, a special version of the deadline model yields the identical prediction of the fast guess model with $a=1$. That is, the deadline model can explain the constancy of the left side of eq.(1-7), too.

As to the speed-accuracy tradeoff, the fast guess model asserts that the error rate should be constant in order that the experimenter can control the subject's strategy. In the fast guess model, the speed-accuracy tradeoff is controlled by the probability of guessing. Equality of the error rates between the experimental conditions means equality of the guessing probabilities between them. However, according to Ollman(1977)'s adjustable timing model, invariance of the error rate does not assure invariance of the strategy.

In the adjustable timing model, the joint density of the type and latency of the responses, $f(r,t)$, is expressed as the product of two probabilities;

$$f(r,t) = A(r|t) \cdot f(t)$$

where $A(r|t)$ is the conditional probability that the response is the specified type($r =$ correct response or error), given the particular value of RT($RT=t$), and $f(t)$ is the marginal probability of the RT. Ollman(1977) insists that $A(r|t)$ is specified only by the task and $f(t)$ is dependent only on the subject's strategy. Hence, in order to assure the invariance of the speed-accuracy tradeoff, the experimenter should control the reaction time, rather than the error rate.

E. Accumulation Model.

Random walk models(Stone(1960), Laming(1962,1968), Link and Heath(1975), Link(1975,1978), Thomas(1975), Swensson and Green(1977)) assumes that the subject accumulates information from periodic samples of the sensory input and responds when this accumulation reaches one of decision boundaries. Link and Heath(1975) derived the following equation;

$$E_A - E_B = \frac{D}{\mu} \cdot \left(\frac{c-1}{c} \right) \quad (1-9)$$

In eq.(1-9), E_A and E_B are the expected numbers of steps to the boundaries for responses, A and B. D is the absolute value of the boundary positions. μ and c are determined by the distribution function of sample values. If the distribution function of sample values is normal or trinomial, $c=1$. In this case, $E_A=E_B$ from eq.(1-9). This means that the mean latency of the correct response is equal to the one of the error. But, if the distribution function of sample values is a Laplace distribution, i.e., difference between two exponential distributions, $c \neq 1$ in general. In this case, $E_A \neq E_B$, which means that the mean latency of the correct response is not equal to the mean latency of the error.

Kintsch(1963)'s model adopts a stochastic mechanism of random walk, although it is not an accumulation model. His model is described by the following equation;

$$Q = \begin{matrix} & \begin{matrix} S & oA & oB & A & B \end{matrix} \\ \begin{matrix} S \\ oA \\ oB \\ A \\ B \end{matrix} & \begin{bmatrix} 0 & 1-a & a & 0 & 0 \\ 0 & 0 & 1-b & b & 0 \\ 0 & 1-c & 0 & 0 & c \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{matrix} \quad (1-10)$$

On each trial the subject begins in the starting state, S, goes to one or the other orienting state(oA or oB), and from there, he either goes on to make the recorded response(A or B) or shifts to the other orienting state(oB or oA). Furthermore, Kintsch(1963) assumes that the time required to complete each transition step is the discrete random variable which follows the geometric distribution,eq.(1-11);

$$P(k) = p^{k-1} \cdot (1 - p) \quad (1-11)$$

From eqs.(1-10) and (1-11), the mean latency of responses for the case $b=c$ can be derived;

$$\text{The mean latency} = \frac{(1+b) \cdot p}{b \cdot (1 - p)}$$

In the recruitment theory proposed by LaBerge(1962), the accumulation process is determined by sampling by replacement. This model assumes that there are three types of elements, C_1 , C_2

and C_0 . C_1 and C_2 elements are connected to responses A_1 and A_2 , respectively. C_0 elements are connected to no response alternatives. The subject chooses response A_1 , when he draws r_1 elements of type C_1 while the number of drawings of type C_2 elements, x , is less than r_2 , where r_1 and r_2 are criterions for responses A_1 and A_2 . With these assumptions, LaBerge(1962) derived the following equation;

$$\begin{aligned} & \text{The average number of total draws (the mean latency)} \\ &= \frac{r_1 \cdot I_{p_1/(p_1+p_2)}(r_1+1, r_2)}{p_1 \cdot I_{p_1/(p_1+p_2)}(r_1, r_2)} \end{aligned}$$

where p_1 and p_2 are the proportions of elements of types C_1 and C_2 , and

$$I_s(t, u) = \sum_{k=0}^{u-1} \frac{(t+k-1)!}{(t-1)! \cdot k!} \cdot s^t \cdot (1-s)^k$$

The variable criterion theory proposed by Grice et al.

(Grice, Nullmeyer and Spiker(1977), Grice, Spiker and Nullmeyer (1979), Grice and Spiker(1979), also cf., Link(1979)) assumes that the accumulation process is deterministic, but the decision criterion is random. The probabilistic character of the decision process is attributed to the random fluctuation of the decision

criterion. According to the variable criterion theory, the excitatory strengths of the correct response and the error at time t , $f_c(t)$ and $f_e(t)$, can be described as follows;

$$f_c(t) = V(t) + A(t)$$

$$f_e(t) = E_c(t) - I(t) - A_D(t)$$

$$= (V(t) - I(t)) + (A(t) - A_D(t)) \quad (1-12)$$

where $V(t)$ is the value of the sensory detection component, $A(t)$ is associative strength of the correct stimulus, $I(t)$ is associative inhibition, and $A_D(t)$ is associative discrimination. If $f_c(t)$ (or $f_e(t)$) reaches the criterion C before $f_e(t)$ (or $f_c(t)$) reaches its criterion, the correct response (or the error) occurs. Eq.(1-12) means that the sensory and associative components, $V(t)$ and $A(t)$, are suppressed by the associative inhibition $I(t)$ and the associative discrimination $A_D(t)$, respectively.

F. Timing and Counting Models.

Green and Luce(1974) examined timing and counting models for two-choice reaction time data. According to these models, the decision is made on the base of the estimation of the rate

of neural pulses. For the estimation, the timing model uses the inter-arrival-intervals of pulses and the counting model uses the number of pulses during a fixed time interval. For these models, Green and Luce(1974) derived the following equations for the mean two-choice reaction times for auditory stimuli;

For the timing model,

$$MRT_1 = \left(\frac{M_1}{M_2}\right) \cdot MRT_2 - \bar{r} \cdot \left(\frac{M_1}{M_2} - 1\right) \quad (1-13)$$

$$\begin{aligned} p_c \cdot MRT_c - p_e \cdot MRT_e \\ = \bar{r} \cdot (p_c - p_e) + h(J, k, \sigma) \cdot \left\{ M_1 \cdot \left[P(1|1) - \frac{1}{2} \right] + M_2 \cdot \left[P(2|2) - \frac{1}{2} \right] \right\} \end{aligned} \quad (1-14)$$

For the counting model,

$$MRT_1 = MRT_2 = \bar{r} + \sigma \quad (1-15)$$

$$p_c \cdot MRT_c - p_e \cdot MRT_e = (\bar{r} + \sigma)(p_c - p_e) \quad (1-16)$$

In the above equations, MRT_1 and MRT_2 are the mean reaction times for the two stimuli, S_1 and S_2 , MRT_c and MRT_e are the mean reaction times of the correct responses and errors, and p_c and p_e are the probabilities of the correct responses and errors. Eq.(1-13) means that MRT_1 is a linear function of MRT_2 . Eq.(1-14) means that $p_c \cdot MRT_c - p_e \cdot MRT_e$ is an approximately

linear function of $p_c - p_e$ when intense stimuli are used, but the former is an accelerated function of the latter when weak signals are used. The meaning of eq.(1-15) is obvious.

According to eq.(1-16), $p_c \cdot MRT_c - p_e \cdot MRT_c$ is an accelerated function of $p_c - p_e$, because $p_c - p_e$ increase with δ . Green and Luce(1974) concluded that the timing model is generally more plausible except in situations when it is distinctly to the subject's advantage to employ the counting mechanism.

G. Preparation Model.

Falmagne(1965)(also cf., Falmagne(1968), Theios and Smith (1972), Lupker and Theios(1977)) proposed a two-state model. According to this two-state model, the subject is either prepared or unprepared for each possible stimulus on any trial. If the subject is prepared (or unprepared) for the stimulus to be presented, his latency is shorter (or longer). The probability of the preparation for a particular stimulus depends on the events on the previous trial. From these assumptions, Falmagne(1965) derived many equations, which describe the sequential effects or

the effects of the probabilities of the possible stimuli.

For example;

$$E(X_{i,n+1}) = (1 - c) \cdot E(X_{i,n}) + c \cdot E(X_k) \quad \text{if } E_{i,n} = 1 \quad (1-17)$$

and

$$E(X_i) = \frac{\pi_i \cdot c \cdot E(X_k) + (1 - \pi_i) \cdot c' \cdot E(X_k)}{\pi_i \cdot c + (1 - \pi_i) \cdot c'} \quad (1-18)$$

Eq.(1-17) describes the relation between the mean reaction times on trials n and $n+1$, $E(X_{i,n})$ and $E(X_{i,n+1})$, if stimulus i is presented on trial n ($E_{i,n} = 1$). Eq.(1-18) describes the relation between the mean reaction time for stimulus i , $E(X_i)$, and the probability of presentation of stimulus i , π_i .

In some article (Falmagne and Theios(1969), Theios(1973), Falmagne, Cohen and Dwivedi(1975), Lupker and Theios(1975)), the preparedness of the subject is interpreted in terms of the process of memory scan. According to these interpretations, the preparedness for a particular stimulus means that the prototype of this stimulus is in short term memory, so is easily processed. Since the capacity of this short term memory is limited, prototypes of some stimuli cannot be in this short term memory and the processing of these stimuli needs more time.

* * * * *

Many models have been proposed, each of which emphasizes a different aspect of choice reaction time. To the author, Falmagne(1965)'s two-state model is most interesting because of the following two reasons;

- 1). It has very simple structure, i.e., it assumes only two states. Comparing two-state, three-state and four-state models, Lupker and Theios(1975) concluded that the two-state model could be accepted, but the three-state and four-state models could be rejected. That is, the model with the smallest number of states was the best.
- 2). The two-state model is a discrete one. The question whether psychological states are discrete or continuous is one of fundamental problems. But, to determine experimentally whether the state is discrete or not is difficult, because the prediction made by a particular model is also dependent on the assumptions other than the one to test. The author is interested in the question how well models with discrete states can do.

Now, let us review literatures on models for simple reaction times.

MODELS FOR SIMPLE REACTION TIMES

A. Time Uncertainty and Simple Reaction Times.

Klemmer(1957) obtained the following equation for the pooled data;

$$RT = .018 \cdot \log_{10} \sigma_T + .235 \quad (1-19)$$

where RT is the mean simple reaction time and σ_T is the measure of total time uncertainty, i.e., the standard deviation derived from adding variances from foreperiod and time-prediction distributions. According to Klemmer(1957), eq.(1-19) means that the averaged speed of information processing in simple reaction task is 18 msec per bit.

B. Thomas(1967)'s Anticipation Model.

Thomas(1967) proposed the model in which the state of readiness plays a central role. He assumed that, if T is the

subject's estimate of t at which the signal will be presented, the subject's state of readiness, SR , would rise to a local maximum proportional to p_t (the conditional probability that the signal would arrive at t given that it has not arrived before t) at T , and then decline. The following equation was proposed as an approximation,

$$SR(z) = \ell \cdot p_t - m \cdot |z - T| \quad (1-20)$$

where ℓ and m are positive constants.

The reaction time, RT_t , was assumed to obey the following equation,

$$RT_t = \begin{cases} f(SR(t)) & (0 < p_t \leq p_x) \\ RT_m & (p_t \geq p_x) \end{cases} \quad (1-21)$$

where

$$f(x) = a + \frac{b}{x}$$

and p_x is a some constant.

If the foreperiod distribution was uniform on the integers 1 to n , then,

$$p_t = \frac{\frac{1}{n}}{1 - (t-1) \cdot \frac{1}{n}} = (n - t + 1)^{-1}, \quad t = 1, 2, \dots, n \quad (1-22)$$

Suppose that the signal arrives at time $i \cdot d$; then the subject has to predict each of the time-point $t \cdot d$, $t=1,2,\dots,i$. It is assumed that the subject predicts one-point starting from the previous one, so that for each prediction the subject predicts an interval of length d and does so with an error \mathcal{E} . It is also assumed that \mathcal{E} is $N(0, \sigma^2)$. Then the error, \mathcal{E}_i , in predicting the interval of length $i \cdot d$ is $N(0, i\sigma^2)$. Then, from eqs.(1-20), (1-21) and (1-22),

$$RT_i = a + b \cdot E\left(\frac{1}{\mu - m \cdot |\mathcal{E}_i|}\right)$$

$$\doteq a + b \cdot (n - i + 1) + b \cdot g \cdot (n - i + 1)^2 \cdot \sqrt{i}$$

where $g = m \cdot \sigma \cdot \sqrt{\frac{2}{\pi}}$, and RT_i is the mean reaction time for foreperiod = $i \cdot d$.

C. Deadline Model.

A deadline model (Ollman and Billington(1972), Kornblum(1973)) assumes that in a simple reaction task the two processes, the signal detection and time estimation processes, race and a faster one determines a reaction time. Let T_c and T_d be the random variables which represent the time of the deadline and the time at which the signal detection may occur. Then, the

measured overt response time, T , is given by

$$T = \min(T_c, T_d)$$

Hence,

$$(1 - F(t)) = (1 - F_c(t)) \cdot (1 - F_d(t))$$

where $F(t) = P(T \leq t)$ and so on.

From the above equation,

$$F_d(t) = \frac{F(t) - F_c(t)}{1 - F_c(t)} \quad (1-23)$$

$F(t)$ is the cumulative distribution of the observed response times, and $F_c(t)$ is given by the response times on the trials where no signal occurred. By eq.(1-23), we can estimate the true reaction time distribution, $F_d(t)$, using $F(t)$ and $F_c(t)$.

D. Recruitment Model.

Recruitment model(LaBerge(1962)) assumes that there are two types of elements, C_1 and C_0 . The elements of type C_1 are connected to the response, but the elements of type C_0 are connected to no responses. The evocation of the response involves the sampling of r elements of type C_1 plus w neutral elements. That is, r is the decision boundary for the response. If m

elements must be drawn to obtain the r th conditional element,
then the latency is given as,

$$\text{latency} = \lambda \cdot m + t_0 \quad (1-24)$$

where λ is the time required for sampling one element, and t_0 is the residual latency. If $m = r + w$, and the proportions of the elements of types C_0 and C_1 are p_0 and p_1 , respectively, then,

$$P(r+w) = \frac{(r+w-1)!}{(r-1)! \cdot w!} \cdot p_1^r \cdot p_0^w \quad (1-25)$$

Hence, from eqs.(1-24) and (1-25),

$$\begin{aligned} \text{the mean latency} &= \lambda \cdot E(r+w) + t_0 \\ &= \lambda \left(\frac{r}{p_1} \right) + t_0 \end{aligned} \quad (1-26)$$

Eq.(1-26) means that, if p_1 is an increasing function of the stimulus intensity, then the mean latency is a decreasing function of the stimulus intensity.

E. Variable Criterion Model.

Variable criterion model(Grice(1968,1972), Grice,Nullmeyer and Spiker(1977)) assumes that the accumulation process is deterministic, but the criterion is randomly varying. The basic formula is given as

$$f(t) = H(t) + V(t)$$

where $f(t)$, $H(t)$ and $V(t)$ are the excitatory strength, the associative strength and the sensory component at time t . The response occurs when the excitatory strength $f(t)$ reaches the criterion T . The criterion T is assumed to be normally distributed. Grice(1977) determined the forms of the functions $H(t)$ and $V(t)$ from the experimental data. The $H(t)$ s were fitted with Gompertz growth functions, $H(t) = a \cdot b^{c^t}$ and the $V(t)$ s were fitted with exponential growth functions, $V(t) = a - b \cdot e^{-c \cdot t}$.

F. Temporal Integration Model.

Hildreth(1973) proposed a temporal integration model of simple reaction time to brief visual stimuli. This model assumes that detection time, T_d , is the time required for the time integral of a nonnegative function, $v(t; d, \ell)$, called the visual response function, to reach some fixed criterion, c . The parameters, d and ℓ , represent the duration and luminance of the presented stimulus. The form of $v(t; d, \ell)$ for a square-wave flash is assumed to be given as,

$$v(t;d,\ell) = \begin{cases} 0 & \text{for } t \leq e_\ell \\ \lambda_\ell & \text{for } e_\ell < t \leq d \\ \lambda_\ell \cdot e^{-\tau_\ell \cdot (t-d)} & \text{for } d < t \end{cases} \quad (1-27)$$

That is, the visual response function $v(t;d,\ell)$ corresponding to a square-wave flash with intensity ℓ and duration d begins as a square-wave with amplitude λ_ℓ at $t=e_\ell$, is maintained until time d , and then decays exponentially following offset of the flash.

Then,

$$V(t;d,\ell) = \int_0^t v(t) \cdot dt = \begin{cases} 0 & t \leq e_\ell \\ \lambda_\ell \cdot (t - e_\ell) & e_\ell < t \leq d \\ \lambda_\ell \cdot (d - e_\ell) + \frac{\lambda_\ell}{\tau_\ell} \cdot (1 - e^{-\tau_\ell \cdot (t-d)}) & d < t \end{cases} \quad (1-28)$$

and

$$V(I_d; d, \ell) = c \quad (1-29)$$

From eqs. (1-27), (1-28) and (1-29), we get the detection time, I_d , as the function of d ,

$$I_d = \begin{cases} \infty \text{ (no detection)} & d \leq \delta_\ell \\ d - \frac{1}{\tau_\ell} \cdot \log(\tau_\ell (d - \delta_\ell)) & \delta_\ell < d < \tau_\ell = \delta_\ell + \frac{1}{\tau_\ell} \\ \delta_\ell + \frac{1}{\tau_\ell} = \tau_\ell & \tau_\ell \leq d \end{cases}$$

where δ_ℓ and τ_ℓ satisfy the following equations,

$$V(\infty; \delta_\ell, \ell) = c$$

and

$$V(\tau_\ell; \tau_\ell, \ell) = c.$$

That is, δ_ℓ is the shortest duration for which a flash with intensity ℓ is above threshold, and τ_ℓ is the shortest duration for which $V(d; d, \ell) > c$.

G. Timing and Counting Models.

According to the timing model (Luce and Green(1972), Green and Luce(1974)), inter-arrival-intervals, IAI's, of the pulses of sensory information is monitored, and the subject responds when the IAI is shorter than the criterion, β , which suggests that the reaction signal has been presented. The train of the pulses is assumed to obey a Poisson process. The following equation is one of the equations derived by Luce and Green(1972) with the assumption that the mean magnitude estimation, ME, is proportional to μ , the parameter of the Poisson process when the signal is presented, i.e., $ME = D/\mu$;

$$\text{the mean RT} \doteq \bar{r} + \begin{cases} \frac{2D}{ME} & \text{for } \mu \text{ large} \\ \frac{D}{ME} + \frac{D^2}{ME^2 \beta} & \text{for } \mu \text{ small} \end{cases}$$

The poisson counting model proposed by Hildreth(1979) is a stochastic version of the temporal integration model proposed by Hildreth(1973). According to this counting model, the onset of the stimulus with intensity ℓ activates N_ℓ parallel Poisson processes with intensity parameter r_ℓ . After the offset of the stimulus with duration d , each of the N_ℓ Poisson processes is left with exactly one more pulse to deliver to the detection center. The subject responds when the K th pulse arrives at the detection center. Hildreth(1979) derived the following equation;

$$\begin{aligned} & E(W_{K,\ell} / \text{detection}) \\ &= P(W_{K,\ell} \leq d) \cdot E(W_{K,\ell} \mid W_{K,\ell} \leq d) \\ & \quad + P(d < W_{K,\ell} < \infty) \cdot E(W_{K,\ell} \mid d < W_{K,\ell} < \infty) \end{aligned} \quad (1-30)$$

where $W_{K,\ell}$ is the random variable for the waiting time required for the K th pulse to arrive at the detection center, i.e., the detection time.

Hildreth(1979) did not give the explicit form of eq.(1-30),

but the distribution function of $W_{K,\ell}$, $f_{K,\ell}(t)$, is given as

$$f_{K,\ell}(t) = \frac{1}{(K-1)!} \cdot N_{\ell} \cdot r_{\ell} \cdot (N_{\ell} \cdot r_{\ell} \cdot t)^{K-1} \cdot e^{-N_{\ell} \cdot r_{\ell} \cdot t} \quad (t > 0)$$

H. Spark Discharge Model.

Ida(1980) proposed a spark discharge model, which is modeled after the phenomena of the occurrence of spark discharge when voltage is applied between electrodes. This model assumes that the decay of neural information from the onset of a stimulus obeys the exponential distribution,

$$f(t) = \lambda \cdot e^{-\lambda \cdot t} \quad (1-31)$$

where λ is a linear function of the stimulus intensity which is further assumed to be a linear function of time, i.e., $\lambda = c \cdot t$.

Hence, eq.(1-31) can be rewritten as follows;

$$f(t) = c \cdot t \cdot e^{-c \cdot t^2}$$

Let $F(t) = \int_0^t f(t) \cdot dt$, then he derived the following equation;

$$F(t) = 1 - e^{-\frac{c}{2} \cdot t^2} \quad (1-32)$$

That is, the distribution of the latencies obeys a Weibull distribution, eq.(1-32).

* * * * *

There are many models for the simple reaction time, too.

The role of expectancy in the simple reaction time has been emphasized by Näätänen and his collaborators(Näätänen(1970,1971), Näätänen and Merisalo(1977), Niemi and Näätänen(1981)). Only one of the models reviewed here gives a central role to the expectancy processes, the anticipation model(Thomas(1967)). But, this model ignores the sequential effects. The reaction time is affected by the foreperiod in the preceding trial(cf!, the results of experiment III in this article, or the review by Niemi and Näätänen(1981)). In this dissertation, the author will propose a new model with the following characteristics;

- 1). The role of anticipation is emphasized.
- 2). The sequential effects are incorporated.
- 3). The model is described in terms of discrete states, i.e., the prepared and not-prepared states.

As to the third point, the author was encouraged by the following conclusion by Lupker and Theios(1977);

" The two-state model should serve as a useful tool in answering some of the basic questions regarding the temporal properties of

human choice behavior."

Although their conclusion was concerned with choice reaction times, the author is interested in the question whether a two-state model is useful in the domain of simple reaction time, or not.

CHAPTER II

EXPERIMENTS

In the previous chapter, we saw that we need a new model, which incorporates the process of expectation (or preparedness) and predicts sequential effects. In order to construct a model, we must collect the data relevant to the model. For our purpose, at least two types of data are necessary. One type of data is concerned to the expectancy of the process of expectation and the other to the sequential effects. Inspecting available evidences reported in published papers, we find some difficulties.

1) Näätänen(1970,1971) made the experiments, where the probability of the presentation of the stimulus at each moment was constant. He expected that under these conditions, the expectancy by the subject would disappear and the FP-RT relation could not be observed. However, we should not confuse objective probabilities with subjective ones, that is, under the conditions where the mathematical probability of the presentation of the stimulus is constant, the subject may expect the stimulus in some moment.

Another approach to effects of the expectancy by the subject

on RT is the attempt by Baumeister and Joubert(1969). They varied the relative frequency of the various FPs to manipulate the expectancy. But, the FPs used by them were 2,4,8,16 sec. These FPs are highly discriminable so that we suspect that the subject might be unduly forced to develop the expectancy during the experiment.

2) In some experiments reviewed by Niemi and Näätänen(1981), FPs were very short, i.e., shorter than 1 sec, and in others, they were very long, i.e., longer than 10 sec. For too short FPs, the subject may not be able to prepare his motor system before the presentation of the stimulus when no warning signal is used.

When too long FPs are used, we suspect that multiple preparation may be invoked, i.e., the process of simple reaction for longer

FPs may not be the same as that for other FPs.

3) Analyzing the data from trained and unexperienced subjects separately, Näätänen and Merisalo(1977) found differences between the two kinds of subjects in the sensitivity of the RT to manipulations of experimental conditions. In general, as to the kind of the subjects, experimenters used trained subjects or

untrained ones, or did not specify the kind of the subjects.

Considering the three difficulties above, the author felt the need to carry out the series of experiments, which satisfy the following conditions;

- 1) Discriminability between the FPs is not so high.
- 2) Lengths of the FPs are not too long and not too short.
- 3) Kind of the subjects is controlled. In the experimnts which will be reported here, all subjects are untrained at least with respect to reaction time experiments.
- 4) Ranges of the FPs used in the experiments are as equal to each other as possible.

In this dissertation, four of the experiments which were made will be reported. Experiments I and II are concerned to the phenomena which can be interpreted as effects of change in expectation. Experiments III and IV are concerned to the sequential effects.

EXPERIMENT I

Two ranges of FPs were used. If expectancy plays a role in a simple reaction task, we can observe shift of the optimum FP, for which the RT is the shortest, when the range of FPs is shifted. Very short FPs entails the problem of refractoriness of responses. Very long FPs entails the problem of boredom. The following two ranges were used, from 1.00 to 3.69 sec, and from 2.84 to 7.01 sec.

Apparatus

The subject was seated in front of a desk, on which a box, 6cm x 20cm x 30cm, was laid. On the upper surface, 20cm x 30cm, of the box, nine microswitches and one red 7-segment LED(Light-Emitting Diode) were laid(Figure 1). One microswitch was at the center of the box and the other eight microswitches were arranged horizontally to fit the arrangement of the eight fingers and they were about 3cm above the switch in the center. The LED was about 5cm above the microswitch in the center. This 7-segment LED displayed the number 0 as the imperative stimulus

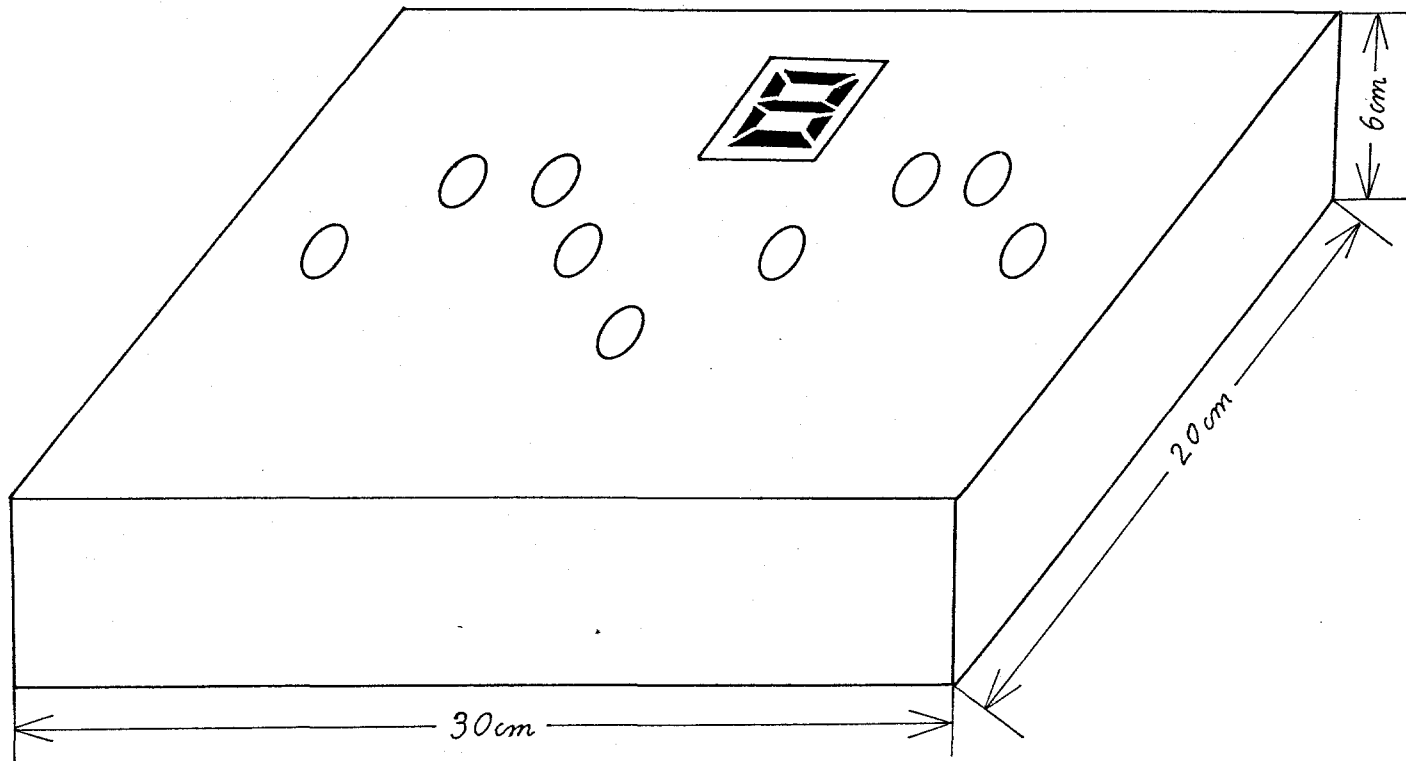


Figure 1. Arrangement of the microswitches and the LED
on the box used in experiments I and II.

and only the microswitch at the center was used as the response switch. AIDACS-3000 microcomputer system(Ai Electronics Corp.) controlled presentation of the stimulus and recorded RTs.

Subjects

Six male students participated in experiment I. They were all untrained with respect to this type of experiment and unpaid.

Procedure

The experiment consisted of 16 blocks, each of which had 51 trials. Each block started by experimenter's key pressing of a CRT display. A trial started with an imperative stimulus which went out when the subject pushed down the microswitch. He was instructed to press the microswitch as fast as possible after the LED lit up. The next trial began after a prescribed time(foreperiod(FP)) elapsed from the subject's response. If the subject responded before the LED lit up, that trial was discarded and the next FP was timed from the preceding false-alarm response. After one block of 51 trials finished, the subject was given as much rest time as he desired to refresh himself. Total times of experiment I were between 40 and 80 minutes.

Two sets of FPs, set S and set L, were prepared. Each set was used in one of two experimental conditions, namely, Short FPs and Long FPs conditions. In the Short FPs condition, the FPs were 1.00, 1.30, 1.69, 2.19, 2.84 and 3.69 sec (set S). In the Long FPs condition, the FPs were 2.84, 3.40, 4.07, 4.88, 5.85 and 7.01 sec (set L). Three subjects (subjects 1,2 and 3) were tested under the Short FPs condition, and the other three (subjects 4,5 and 6) in the Long FPs condition. In a block, 50 FPs were used. The first two FPs were 2.00 sec in the Short FPs condition, and 5.00 sec in the Long FPs condition. The other 48 FPs were randomized sequence of eight set Ss in the Short FPs condition and of eight set Ls in the Long FPs condition.

The programs which were used in experiment I are given in appendix A.

RESULTS

The data from blocks 2 to 16 were used. Trials in which the subject responded before the LED lit up were discarded. Too slow

RTs were also discarded, because these were produced by the subject's distraction and so on. Proportions of these discarded trials were between 0 and 1 % when calculated individually.

Figures 2a and 2b depicts the mean RTs graphically for separate subjects. ANOVA(Analysis of Variance) shows that differences in RTs between FPs are significant at 5 % level, except for subject 6. The differences for subject 6 can be observed at 10 % level.

In summary, we can conclude that optimum FP in the Short FPs condition is between 2.19 and 2.84 sec, and, in the Long FPs condition, between 4.88 and 5.85 sec. That is, optimum FP depends on the range from which the FPs are sampled.

EXPERIMENT II

In experiment II, the range of FPs is fixed, but the relative frequencies of FPs are varied. If the subject anticipates the time point at which the stimulus appears, he may be induced to expect the FP which is subjectively most often used. Two sets

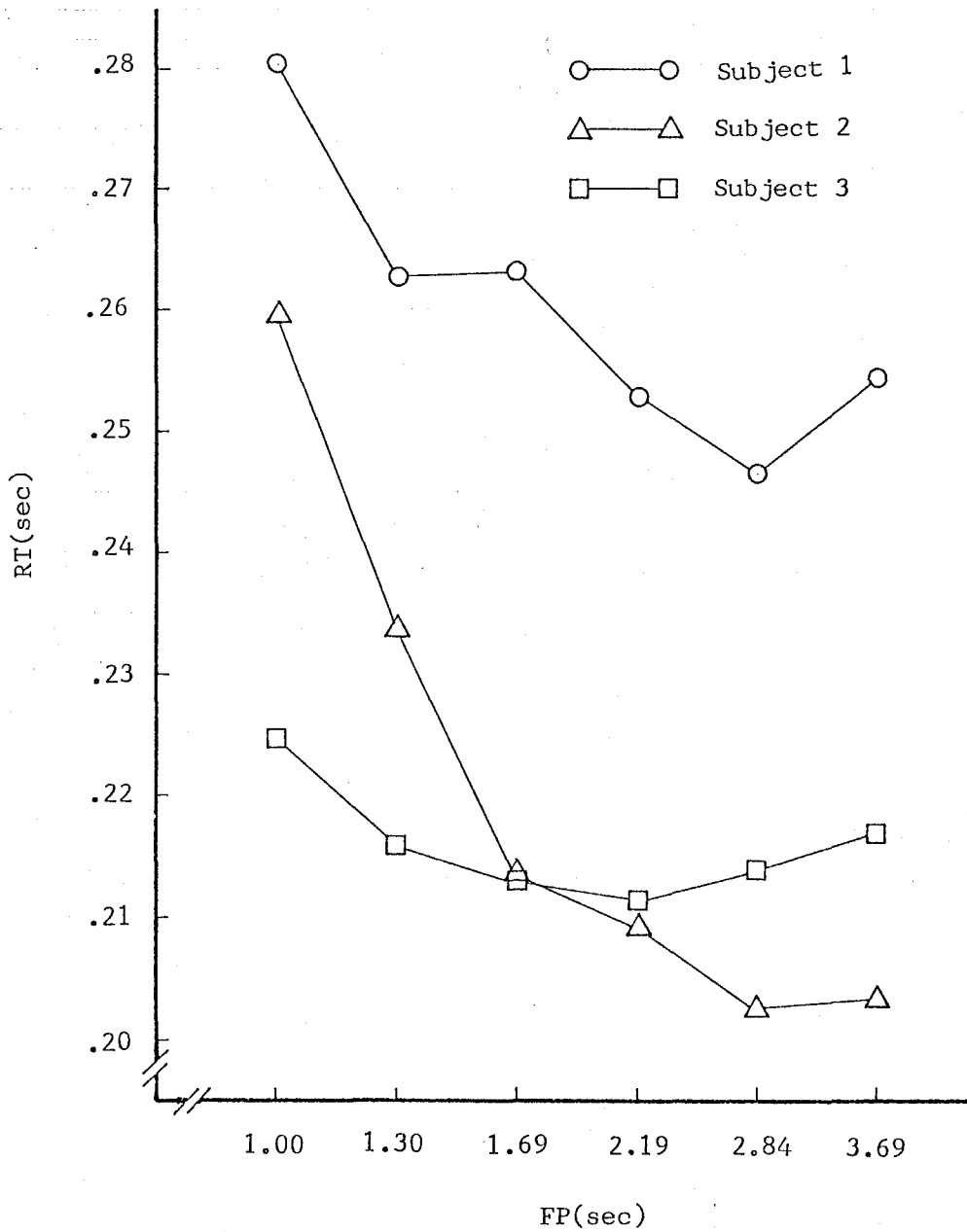


Figure 2a. Mean RTs as a function of FP for separate subjects.

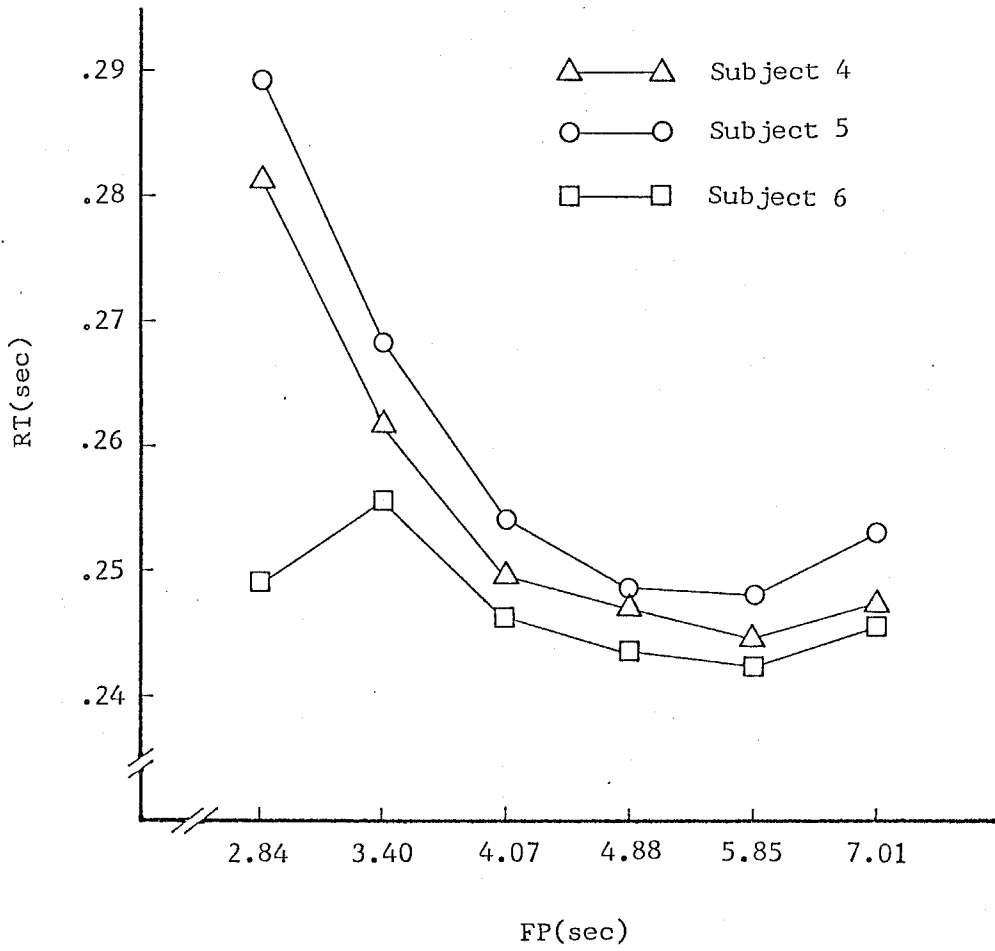


Figure 2b. Mean RTs as a function of FP for separate subjects.

of frequencies are used. In set Sw of FPs, shorter FPs are more often used than longer ones. In set Lw, longer FPs are more often used than shorter ones. It is predicted that the optimum FP is shorter for set Sw than for set Lw.

Apparatus

The apparatus used in experiment II was the same as in experiment I.

Subjects

Six male subjects participated in experiment II. They were all untrained with respect to this type of experiment and unpaid. No one subject participated in both experiment I and II.

Procedure

The procedure was the same as in experiment I except for the following points;

Experiment II consisted of 24 blocks, each block with 103 trials. Twenty-four blocks were divided into two sessions of 12 blocks each. Two sets of FPs were prepared, set Sw and set Lw. In group Sw, there were three 1.00, one 1.30, three 1.69, one 2.19, one 2.84 and one 3.69 sec FPs. In set Lw,

one 1.00, one 1.30, one 1.69, three 2.19, one 2.84 and three 3.69 sec FPs. That is, in set Sw, shorter FPs were weighted and, in set Lw, longer FPs weighted. In a block, 102 FPs were used. The first two FPs were 2.00 sec. The other 100 FPs were consisted of a randomized sequence of ten set Sw's or ten set Lw's. In order to investigate contextual effects on RT under a within-subject design, the following two conditions were prepared. In the S-L condition, FPs used in the first session belonged to set Sw, and FPs in the second session to set Lw. In the L-S condition, FPs used in session 1 belonged to set Lw and FPs in session 2 to set Sw. Three subjects (subject 7,8 and 9) were tested under the S-L condition, and the other three (subjects 10,11 and 12) under the L-S condition. Total times of experiment II were between 120 and 140 minutes.

The programs which were used in experiment II are given in appendix B.

RESULTS

The data from blocks 2 to 12 of sessions 1 and 2 were used. Trials in which the subject responded before the LED lit up were discarded. Too slow RTs were also discarded because these RTs were caused by the subject's distraction and so on. Proportions of these discarded trials from blocks 2 to 12 of sessions 1 or 2 were below 2 % when calculated individually.

For each subject, ANOVA was applied to FP(1.30 vs. 2.84 sec) x context from which the FPs were picked out(shorter vs. longer FPs weighted, i.e.,session 1 vs. 2). Table I summarizes the results. The interaction effect was significant at 5 % level for subjects 7,8 and 10. Figures 3a,3b and 3d show mean RTs of subjects 7,8 and 10 for various FPs. As to subject 11, the median test showed that medians of RTs for 1.00, 1.30 and 1.69 sec FPs were significantly different at 5 % level when longer FPs were weighted, and not significantly different when shorter ones were weighted. From this difference we can conclude that, for subject 11, the optimum FP, when longer FPs were being weighted, was shifted toward a longer FP than when shorter ones were weighted. As to subjects 9 and 12, no statistically

Table I
Significant effects in ANOVA of experiment II

	Subject 7	subject8	subject 9	subject 10	subject 11	subject 12
main effect of context	non.	sig.	sig.	sig.	sig.	sig.
main effect of FP	non.	non.	non.	non.	non.	sig.
Interaction effect	sig.	sig.	non.	sig.	non.	non.

Note: sig.: significant at 5% level; non.: nonsignificant at 5% level.

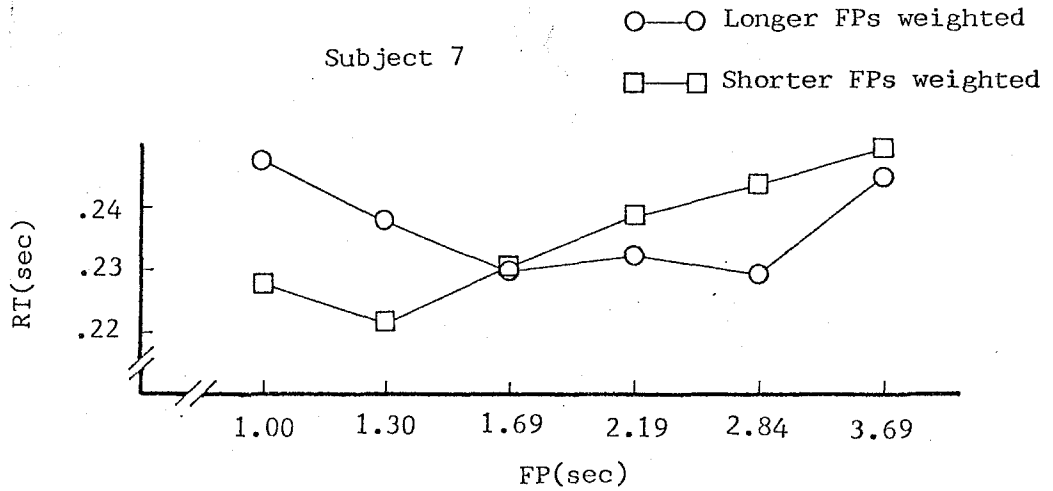


Figure 3a. Mean RTs as a function of FP for subject 7.

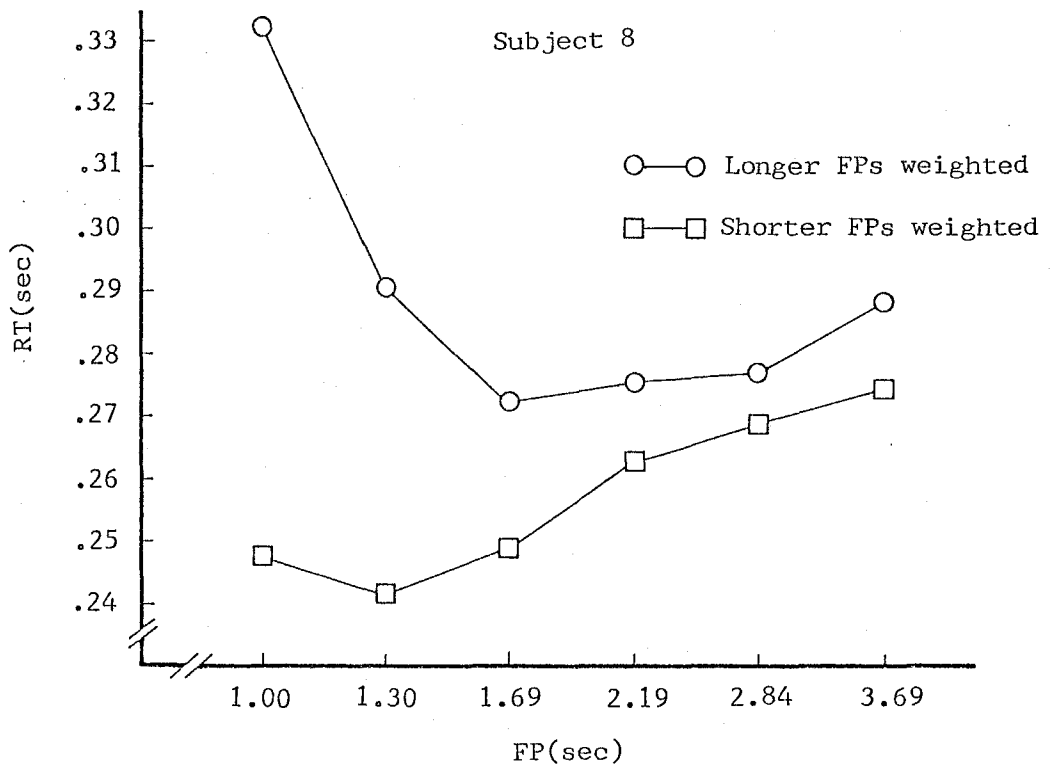


Figure 3b. Mean RTs as a function of FP for subject 8.

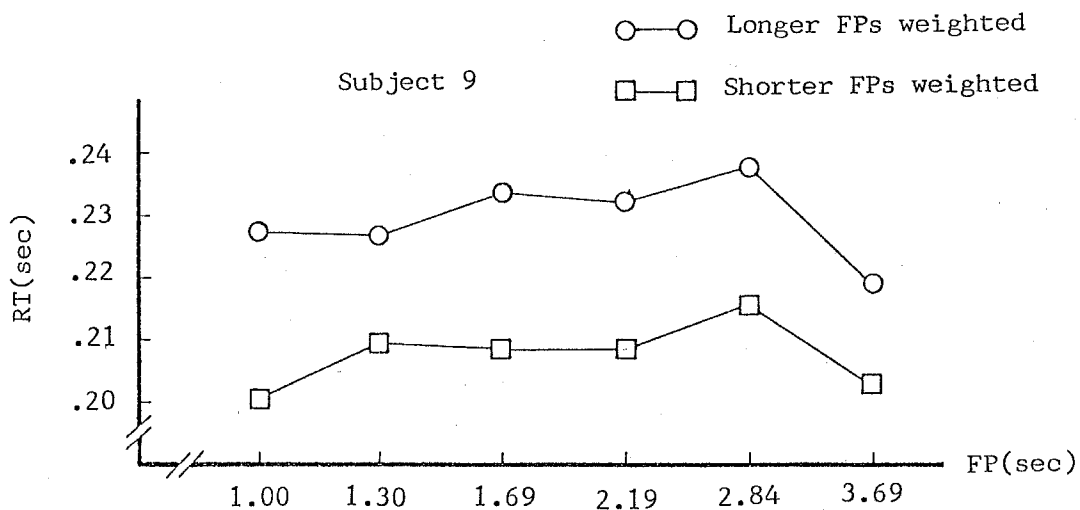


Figure 3c. Mean RTs as a function of FP for subject 9.

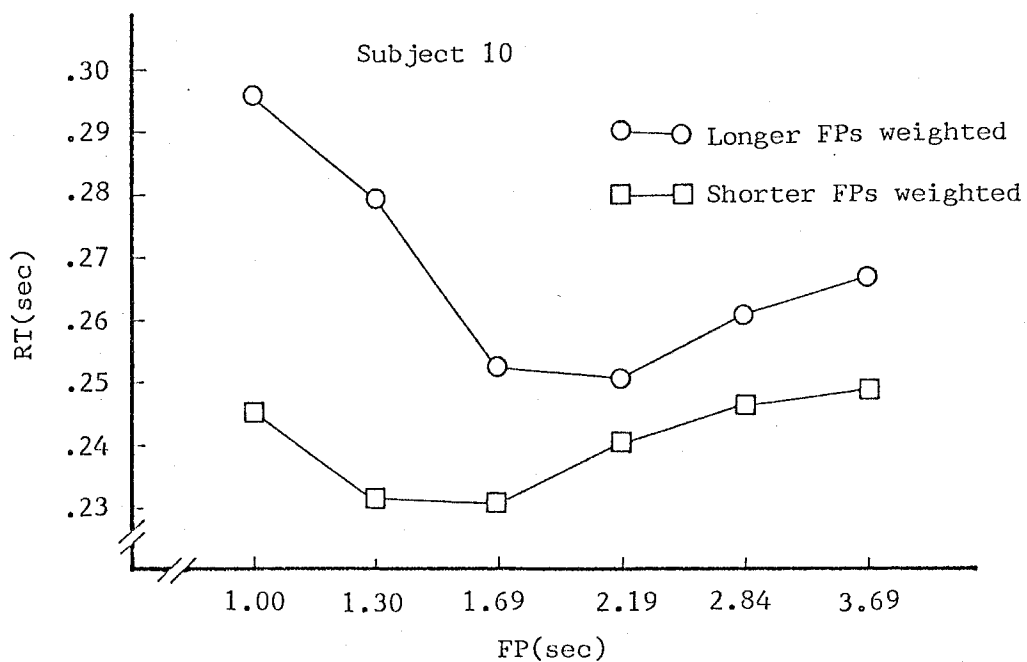


Figure 3d. Mean RTs as a function of FP for subject 10.

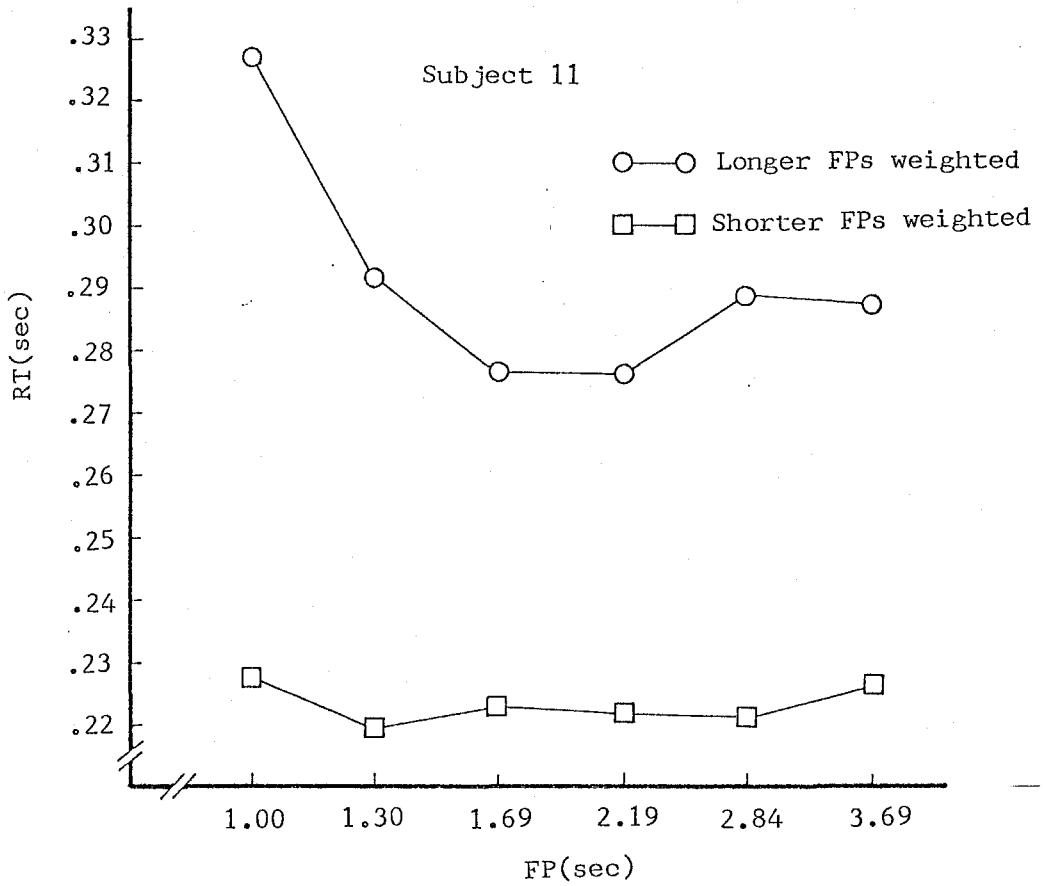


Figure 3e. Mean RTs as a function of FP for subject 11.

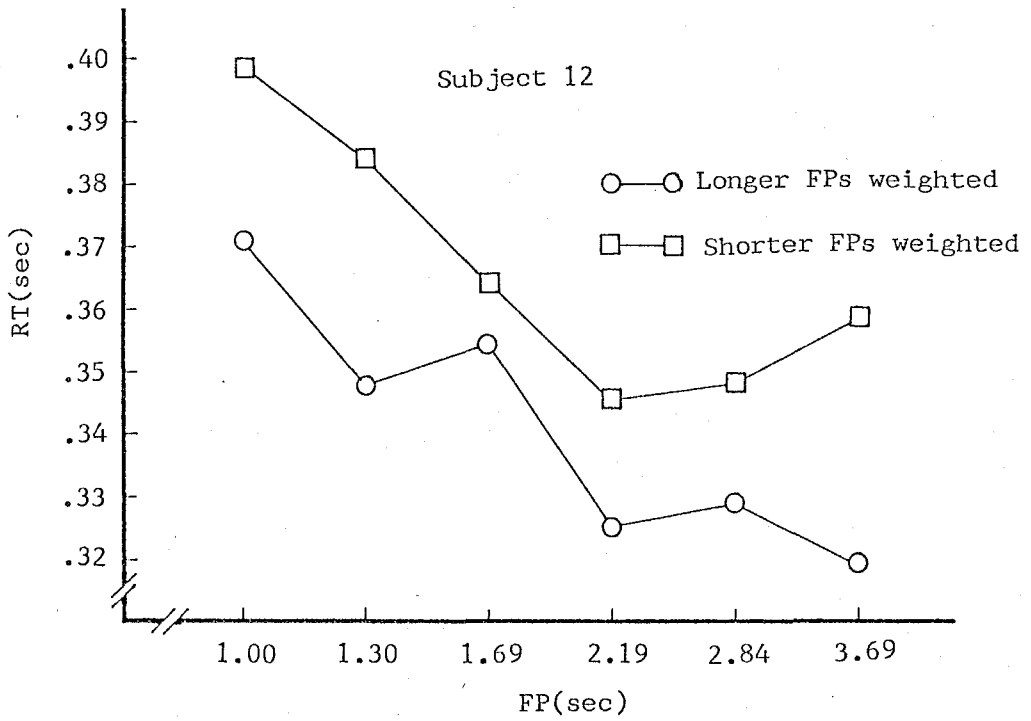


Figure 3f. Mean RTs as a function of FP for subject 12.

significant results which might show an effect of change in weight on optimum FP could be found. But as to subject 12, the pattern of the graph shows the optimum FP is shorter for the shorter FPs weighted condition than for the longer FPs weighted condition, although no significant statistical evidence could be found.

Considering the general pattern of the results obtained from experiment II, we can conclude that change in weight on FPs can bring about shift of optimum FP.

EXPERIMENT III

When the subject anticipates the time point at which the next stimulus will be presented, his anticipation may be affected by the preceding context of the experimental situation. Reaction times for a particular FP may depend on the FP at the preceding trial.

In experiment III, this dependency of RT on the FP at the preceding trial were investigated.

Apparatus

The subject was seated in front of a desk, on which a box, 5cm x 14cm x 24cm, was laid. On the upper surface, 14cm x 24cm, of the box, two microswitches and one 7-segment LED(green) were laid(Figure 4). These microswitches were arranged horizontally, separated 12cm apart, 4cm above the nearest edge of the box to the subject. The LED was mounted between and 6cm above the microswitches. When the LED, which was the imperative stimulus to respond to, lit up, it always displayed number 0. An AIDACS-3000 microcomputer system(Ai Electrics Corp.) controlled these apparatus and recorded responses of the subject.

Subjects

Three students from the undergraduate course of the faculty of letters of Kyoto University participated. They were all untrained with respect to this type of experiment.

Procedure

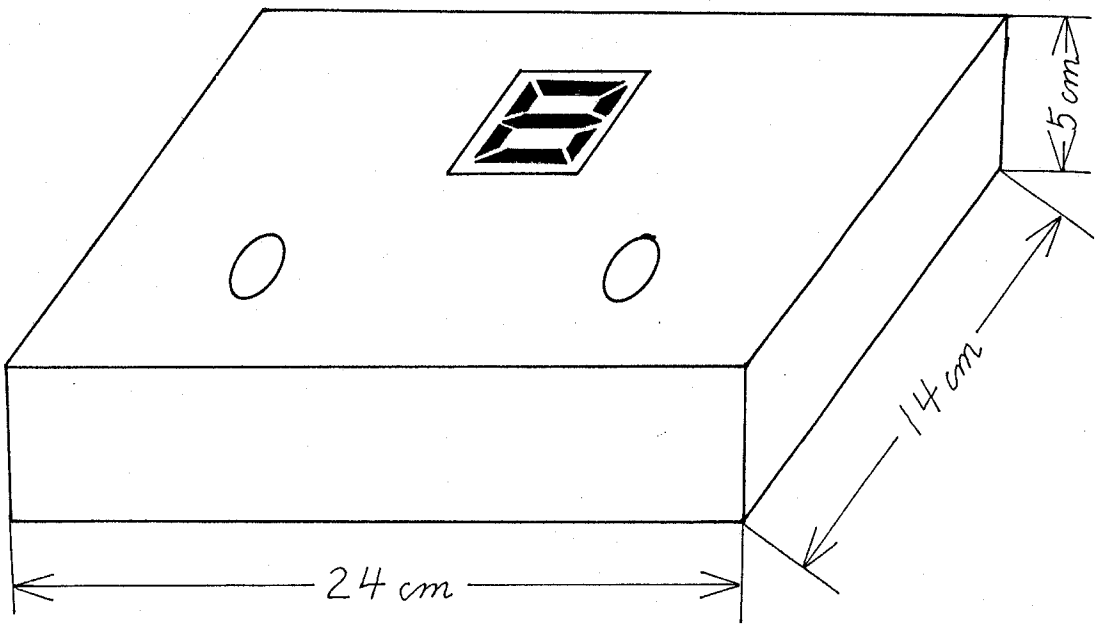


Figure 4. Arrangement of the microswitches and the LED on the box used in experiments III and IV.

The experiment consisted of 7 blocks, each of which had 103 trials. Each block started when the subject pressed down the left microswitch. When 0.5 sec had passed after this response, the LED lit up. The subject was instructed to press down the right microswitch as fast as possible when the LED lit up. The LED went out immediately when the subject responded. After some time (FP) had passed, the next trial began, that is, the LED lit up and the subject responded. An FP-LED-response cycle was repeated until the end of the block.

In a block, 102 FPs were used. The first two FPs were 2 sec. The other 100 FPs were in a randomized sequence of 20 sets of FPs. Each set consisted of 1.00, 1.30, 1.69, 2.19 and 2.84 sec FPs. It was randomized with the following restriction; 1.00, 1.69 and 2.84 sec FPs were preceded by each of the members of the set, which included itself, at least two times, respectively.

The subject was allowed to rest between blocks as long as he would like to.

The program for experiment III is given in appendix C.

RESULTS

Total times of experiment III were between 27 and 54 minutes. The data from blocks 2 through 7 were used, although the first 3 RTs and RTs for immediate FPs of 1.30 and 2.19 sec were discarded. Blocks 2 and 3 (blocks 4 and 5, blocks 6 and 7, respectively) were pooled as session 1 (session 2, session 3, respectively). The medians of RTs to 1.00, 1.69 and 2.84 sec FPs, which were classified according to the FPs in the preceding trials, were calculated. To calculate mean RTs for each combination of the immediate FPs and the preceding FPs of individual subjects, these medians were averaged over the three sessions. These mean RTs were analyzed by ANOVA with the design, immediate FP(1.00, 1.69 and 2.84 sec) x preceding FP(1.00, 1.30, 1.69, 2.19 and 2.84 sec). Main effect of immediate FP and the interaction effect of immediate FP x preceding FP were significant at 5 % level. This results indicates that mean RT is dependent on immediate FP and the preceding FP (Figure 5).

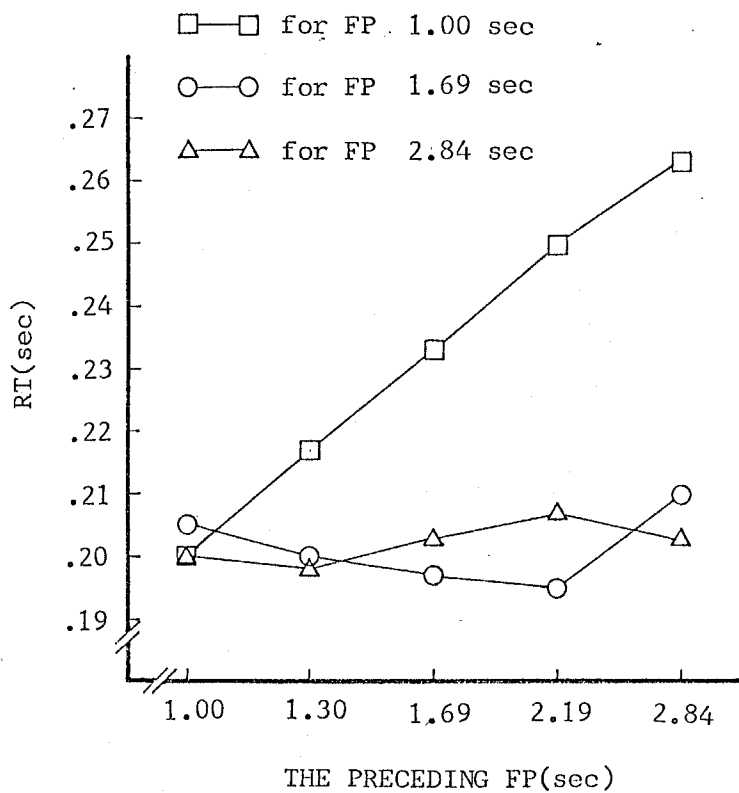


Figure 5. The mean RTs for immediate FP 1.00, 1.69 and 2.84 sec as a function of the FP in the preceding trial.

EXPERIMENT IV

In experiment I, II and III, the subject's response terminated the trial and started the next trial. That is, foreperiod(FP) was timed from the subject's response to the stimulus.

But, FP can be timed from another event, e.g., a warning signal. In this case, the sequence of the events in a trial is as follows; the warning signal - FP - the stimulus - the response. That is, there is a time lag between the response and the start of the next FP. This time lag may have some effect on the sequential effects found in experiment III.

In experiment IV, to investigate this possibility, an interval was inserted between the response and the start of the next FP.

Apparatus

The apparatus used in experiment IV was the same as in experiment III, except that, in experiment IV, an electric buzzer was used as a feedback signal.

Subjects

Eight subjects from the undergraduate course of the faculty of letters of Kyoto University participated in experiment IV.

They were all untrained with respect to this type of experiment.

Procedure

The procedure was the same as in experiment III, except for the following points;

Experiment IV consisted of 10 blocks, which were divided into 2 groups, sessions 1 and 2. In one of the two sessions, the experimental condition was the same as in experiment III (the continuous condition). In the other session (the discrete condition), each trial began after the buzzer sounded for 0.2 sec. In the first trial, the buzzer sounded when the experimenter pushed down the start key on the CRT display. After trial 2, the buzzer sounded after 0.5 sec had passed on from the subject's response, pressing down the right switch, to the LED in the preceding trial. After the buzzer sounded, the subject was allowed to press the left switch. FPs were timed after this left switch pressing. If he pressed down the left switch

before 0.5 sec had passed after the preceding response or during the sounding of the buzzer, the buzzer continued to sound for 5 sec after the release of the left switch. By this prolonged sounding, the subject was informed that he pressed down the left switch too early.

Four subjects served in the continuous (or discrete) condition in session 1 (or 2, respectively), and the other four the discrete (or continuous) condition in session 1 (or 2, respectively).

The programs which were used in experiment IV are given in appendix D.

RESULTS

Total times of experiment IV were between 48 and 71 minutes. The data from blocks 2 to 5 and from blocks 7 to 10 were used, although the first 3 (or 2) RTs of each block in the continuous (or discrete, respectively) condition and RTs for the immediate FPs of 1.30 and 2.19 sec were discarded.

Table II. The mean RT(sec) for immediate FPs of 1.00, 1.69 and 2.84sec as a function of the FP in the preceding trial.

		FP in the preceding trial(sec)				
		1.00	1.30	1.69	2.19	2.84
FP in the immediate trial(sec)	1.00	.205	.217	.221	.232	.243
	1.69	.198	.199	.205	.207	.216
	2.84	.201	.199	.201	.202	.203

Medians of RTs for each combination of 3 immediate FPs, 1.00, 1.69 and 2.84 sec, and the preceding FPs, 1.00, 1.30, 1.69, 2.19 and 2.84 sec, were calculated for sessions 1 and 2. These medians were analyzed by ANOVA with the design, FP (1.00, 1.69 and 2.84 sec) x the preceding FP (1.00, 1.30, 1.69, 2.19 and 2.84 sec) x conditions of sessions (continuous vs. discrete) x order of conditions (from the continuous(in session 1) to the discrete condition(in session 2) vs. from the discrete(in session 1) to the continuous condition(in session 2)).

Main effects of immediate FPs and of the preceding FPs, and interaction effect of immediate FP x the preceding FP were significant at 5 % level. The use of the warning signal had no statistically significant effects. Medians of RTs, which were averaged over non significant factors, were summarized in Table II.

DISCUSSION

The results of experiments I and II suggest that expectation

plays some role in simple reaction task and the results of experiments III and IV indicate that this expectation in part depends on the FP in the preceding trial. These conclusions are compatible with the review by Niemi and Näätänen(1981).

Of course, expectation or anticipation of the occurrence of the stimulus in simple reaction task depends on the perception of time. Hence, we must review studies on the time perception, before we construct a new model, which is based on the process of anticipation.

CHAPTER III

TIME PERCEPTION

A. The Power Law.

Many authors adopted power functions as psychophysical functions, which relate subjective time to physical one. Ekman(1958) proposed the model, which determined the exponent by the method of fractionation. In the method of fractionation, the subject is instructed to adjust a variable stimulus so that it appears subjectively equal to a certain fraction of the standard, usually half the standard. Ekman(1958) set the power function as eq.(3-1),

$$R = C(S - S_0)^n \quad (3-1)$$

where R (or S) is a subjective (or physical) scale of time, C is a constant related to the unit of measurement of R, S_0 is a kind of absolute threshold, and n is the exponent determining the curvature of the function.

When the subject adjusts the variable stimulus to a value, S_p , which, subjectively, is p times that of the subjective value of the standard, S,

$$pR = C(S_p - S_0)^n \quad (3-2)$$

Combining eqs.(3-1) and (3-2) and solving for S_p ,

$$S_p = S_0(1-k) + kS \quad (3-3)$$

where $k = p^{1/n}$.

Eq.(3-3) describes a relation between S , a standard stimulus, and S_p , a variable stimulus. Applying eq.(3-3) to the data, we can get the value of k , the slope of eq.(3-3), and $S_0(1-k)$, the intercept when $S=0$.

From the values of k and $S_0(1-k)$, we can get

$$n = \frac{\log p}{\log k}$$

and

$$S_0 = \frac{S_0(1-k)}{1-k}$$

With these values of n and S_0 , we can specify eq.(3-1) except the unit parameter, C .

The model proposed by Björkman and Holmkvist(1960) incorporated the effect of time-order. Their model is based on the power law, $R = C(S - S_0)^n$, and the empirical relation (eqs.(3-4) and (3-5)) between the standard stimulus, S , and the variable stimulus, S_L and $S_{1/2}$, where S_L and $S_{1/2}$ are the adjusted

stimulus as equal to or as half of the standard stimulus S.

$$S_L = bS + a \quad (3-4)$$

$$S_{1/2} = b_1S + a_1 \quad (3-5)$$

Let $P_r(t)$ be the proportion retained after t time passed from the end of S. For a suitable pair of standard stimuli, S_1 and S_2 , $S_L = S_{1/2}$. For this pair of S_L and $S_{1/2}$ ($=t$),

$$\begin{aligned} & \frac{(S_L - S'_0)^n}{(S_1 - S_0)^n} \\ &= P_r(t) \\ &= \frac{2(S_{1/2} - S'_0)^n}{(S_2 - S_0)^n} \end{aligned}$$

where S_0 and S'_0 are the absolute thresholds for the standard and variable stimuli.

Substituting for S_1 and S_2 the values obtained from eqs.

(3-4) and (3-5),

$$\begin{aligned} & \frac{b^n(S_L - S'_0)^n}{(S_L - a - bS_0)^n} \\ &= P_r(t) \\ &= \frac{2b_1^n(S_{1/2} - S'_0)^n}{(S_{1/2} - a_1 - b_1S_0)^n} \end{aligned}$$

Substituting t for S_L and $S_{1/2}$,

$$b^n \left[\frac{t - S'_0}{t - a - bS_0} \right]^n = 2b_1^n \left[\frac{t - S'_0}{t - a_1 - b_1S_0} \right]^n$$

hence

$$\frac{b}{t-(a+bS_0)} = \frac{2^{\frac{1}{n}} b_1}{t-(a_1+b_1S_0)}$$

This should hold for all positive values of t .

Thus,

$$n = \frac{\log \frac{1}{2}}{\log(\frac{b_1}{b})}$$

and

$$S_0 = \frac{a_1 - a}{b - b_1}$$

Eisler(1975) derived the power law from the empirical linearity described as eqs.(3-4) or (3-5), which is formulated again as eq.(3-6),

$$\Phi_V = a \Phi + b \quad (3-6)$$

where Φ denotes the physical value of the standard duration, and Φ_V the variable duration (these notational changes are in accord to Eisler's notation.).

Let f and g be the psychophysical functions which relate subjective values, ψ and ψ_V , to physical values, Φ and Φ_V , as follows,

$$\psi = f(\Phi) \quad (3-7)$$

$$\psi_V = g(\Phi_V) \quad (3-8)$$

If the subject carried out an r setting, we have

$$\psi_V = r \psi \quad (3-9)$$

Eqs.(3-6) to (3-9) yield

$$r f(\Phi) = g(a\Phi + b) \quad (3-10)$$

Taking the derivative of eq.(3-10) with respect to r yields

$$f(\Phi) = (a'\Phi + b') \cdot g'(a\Phi + b) \quad (3-11)$$

and with respect to Φ yields

$$r f'(\Phi) = a g'(a\Phi + b) \quad (3-12)$$

Dividing eq.(3-12) by eq.(3-11) yields

$$\frac{r f'(\Phi)}{f(\Phi)} = \frac{a}{a'\Phi + b'} \quad (3-13)$$

and integrating eq.(3-13) with respect to Φ yields

$$r \log f(\Phi) = \frac{a}{a'} \log |a'\Phi + b'| + C_1(r)$$

or

$$f(\Phi) = C(r) \cdot (a'\Phi + b')^{\frac{a}{a'r}}$$

Because $f(\Phi)$ is independent of r, $f(\Phi)$ is rewritten in the following way,

$$\psi = f(\Phi) = \alpha (\Phi - \Phi_0)^{\beta}, \quad \Phi > \Phi_0$$

Eisler(1976) reviewed 111 studies from 1868 to 1975 and concluded that a value of .9 seemed to come closest to the

exponent of subjective duration. From table 1 in the review by Eisler(1976), we can see the exponents ranging from .31 to 1.36.

Blankenship and Anderson(1976) tested their simple weighted sum model, eq.(3-14), for time perception.

$$R_{ij} = A(w_1 d_i + w_2 d_j) + B \quad (3-14)$$

They had the subject to rate the total duration, R_{ij} , of two time intervals, d_i and d_j , which were presented successively.

Analyzing their data by ANOVA, they concluded that eq.(3-14) was confirmed

Cuttis and Rule(1977) proposed a more general model, eq.(3-15), than eq.(3-14),

$$J_{ij} = a[w\phi_i^k + (1-w)\phi_j^k]^m + b \quad (3-15)$$

where J_{ij} denotes the judgement by the subject, ϕ_i and ϕ_j denote the two stimuli, w denotes the weight, and a and b are coefficients of the linear equation.

Curtis and Rule(1977) got the values of parameters in eq. (3-15) as follows,

$$J_{ij} = .95(.51\phi_i^{1.94} + .49\phi_j^{1.94})^{.49} + .94 \quad (3-16)$$

for judgment of total magnitude of simultaneously presented temporal intervals,

and

$$J_{ij} = .53(.46\phi_i^{1.09} + .54\phi_j^{1.09})^{1.08} + 1.25 \quad (3-17)$$

for judgments of average duration of successively presented stimuli.

With the assumption that subjective duration is related to measured duration by a linear function, both equations can be rewritten as follows,

For eq.(3-17),

$$\psi_{ij} = \psi_i + \psi_j \quad (3-18)$$

For eq.(3-16),

$$\psi_{ij} = (\psi_i^2 + \psi_j^2)^{\frac{1}{2}} \quad (3-19)$$

That is, they concluded that (1) when the information to be integrated was presented sequentially, the judgment was made in the way which was consistent with a linear composition rule, eq.(3-18), and (2) when the information was presented simultaneously, judgments were based on the vector summation rule, eq.(3-19).

B. Logarithmic Psychophysical Law.

In his model of the "internal clock", Treisman(1963) adopted a logarithmic function to represent the magnitude of the time interval stored in the short term memory.

Treisman(1964) criticized the psychophysical power law. He argued; "... a model sufficient to account for the result of any direct scaling experiment can be based on either a power function or a log function law. This is true of each scaling procedure, not just of fractionation, when the model is adapted appropriately."

For example;

Let the weight W_c was chosen as being subjectively half as great as the given weight W_s . If the power law was adopted,

$$2 W_c^n = W_s^n$$

hence,

$$n \log W_s - n \log W_c = \log 2$$

That is, if we write,

$$S = n \log W + C$$

then

$$S_s - S_c = \log 2 \quad (3-20)$$

Eq.(3-20) means, according to Treisman(1964), that the log function can also describe the data from the ratio (1/2) setting experiment, as well as the power function does.

C. Weber's Law Models.

Getty(1975) compared Weber's law models with counter models. He generalized Weber's law as follows,

$$\text{Var}(T) = k_W^2 \cdot T^2 + V_R \quad (3-21)$$

where $\text{Var}(T)$ is the total variance, V_R is sum of the all magnitude-independent variances and $k_W^2 \cdot T^2$ is sum of the all magnitude-dependent variances.

Square-root of $k_W^2 \cdot T^2$ is $\sqrt{k_W^2 \cdot T^2} = k_W \cdot T$, so k_W is the Weber fraction.

According to the counter model, which was proposed by Creelman (1962), the total variance can be divided as follows,

$$\text{Var}(T) = k \cdot T + V_R \quad (3-22)$$

That is, the sum of the all magnitude-dependent variances is proportional to stimulus magnitude (time interval) T .

In general, Poisson counter models produce the variance and the mean, both of which are proportional to the time interval T ,

in which the counting was made.

Distribution of number of counts in an interval T approaches to normal distributions with a mean $\lambda \cdot T$ and a variance $\lambda \cdot T$, as T becomes larger. So, Kinchla(1972), in his data analysis, used a Gaussian random variables.

Getty(1975) tested eq.(3-21) and eq.(3-22) against his data from his forced-choice experiment and concluded that Weber's law model is better.

Getty(1976) also compared Weber's law models with proportional variance models, using the silent counting task, and reached to the same conclusion as in Getty(1975).

D. Constant Variance Models.

In the model proposed by Allan, Kristofferson and Wiens (1971), variances associated with time perception are constant irrespectively of length of time intervals. They conceptualized the mechanism of time perception as follows;

Suppose that at some time after the onset of a d_1 -msec stimulus, an interval timing process is activated by the stimulus onset. This delay is called the psychological onset time.

Similarly, the offset of the stimulus terminates the internal timing process after a time delay called the psychological offset time. The psychological onset and offset times were assumed to have uniform distributions, $f_1(u)$ and $f_2(u)$, respectively.

$$f_1(u) = \begin{cases} 1/q & \text{if } 0 < u < q \\ 0 & \text{otherwise} \end{cases}$$

and

$$f_2(u) = \begin{cases} 1/q & \text{if } d_i < u < d_i + q \\ 0 & \text{otherwise} \end{cases}$$

where q is constant irrespective of d_i .

Then, the distribution of durations of the internal timing process, denoted as $g(u')$, is

$$g(u') = \int f_2(u) \cdot f_1(u - u') \cdot du$$
$$= \begin{cases} \frac{q + d_i - u'}{q^2} & \text{if } d_i < u' < d_i + q \\ \frac{q - d_i + u'}{q^2} & \text{if } d_i - q < u' < d_i \\ 0 & \text{otherwise} \end{cases}$$

That is, the graph of $g(u')$ is an isosceles triangle with a base of $2q$ msec.

The real-time criterion model by Kristofferson(1977) also

made the distribution of the time at which a criterion occurs an isosceles triangle.

E. Nontemporal Factors.

Hornstein and Rotter(1969) found effects of sex and methods on temporal perception. They employed three methods, the method of verbal estimation (MVE) in which a subject makes a verbal judgment of the length of a physical interval, the method of production (MP) in which a subject must translate a verbalized interval into a physical one, and the method of reproduction (MR) in which a subject must reproduce physically an interval of a given duration first presented physically by an experimenter. Their data showed that (1) as to male subjects, in MR, they reproduced shorter intervals than presented, but, in MVE and MP, their responses were accurate, and (2) as to female subjects, in MVE, their verbal estimations were larger than physical ones, but, in MP and MR, they produced or reproduced shorter intervals.

Cahoon and Edmonds(1980) investigated an effect of expectancy on time estimation. They instructed the experimental subjects as follows: "There will be a delay in starting the experiment.

I will return for you when we are ready. Would you mind calling me in the other room when the water starts boiling? Thanks."

In the instruction to the control subjects, reference to the water was omitted. After giving the instruction, the experimenter left the room for 240 sec. At the end of that interval, the experimenter returned and asked the subject to estimate the elapsed time. The experimental group tended to overestimate the time relative to the control group.

Thomas and Weaver(1975, also cf. Thomas and Cantor(1975)) proposed the following model:

A visual stimulus is analyzed by a timer called f processor and by visual information processors called g processors. The output, $f(t, I)$, of the f processor is a temporal encoding which is directly related to t and the amount of attention allocated to the timer. The output, $g(I, t)$, of the g processors contains encodings of the nontemporal stimulus features and an encoding, $g^*(I, t)$, of the time spent processing I . It is assumed that perceived duration, \mathcal{T} , is a weighted average,

$$\mathcal{T} = a \cdot f(t, I) + (1 - a) \cdot g^*(I, t)$$

Massaro and Idson(1978) investigated perception of duration of the tones which were followed by masking tones. They proposed the following model,

$$JD = PD + K \cdot t_m \quad (3-23)$$

and

$$PD = X + Y \quad (3-24)$$

where

$$X = \alpha \cdot [1 - e^{-(\theta_p \cdot t_p)}]$$

and

$$Y = (\alpha - X) \cdot [1 - e^{-(\theta_i \cdot t_i)}]$$

PD is the perceived duration of the target tone and JD is the judged duration of the target. Eq.(3-23) means that JD is PD plus a constant proportion, K, of mask duration, t_m . Eq.(3-24) means PD consists of two components, X and Y. X is the perceived duration obtained during the actual duration of the target. The value of α is the asymptotic value of perceived duration, θ_p represents the rate of growth of PD during the time of target presentation, t_p . Y is the component which is added during the silent interval, t_i , following target offset. θ_i represents

the growing rate during this silent interval.

Pöppel(1978) proposed a taxonomy of time experiences into five elementary ones (experience of duration, simultaneity/successiveness, sequence, present, and anticipation). His basic assumption is that time perception has to be related to the occurrence of events as they are perceived and actions taken by the subject. Duration estimation of longer intervals is determined by the amount of information processed (and/or stored) or by the mental content. As to experiences of simultaneity/successiveness, he pointed out two aspects of temporal resolving power, that is, fusion and order thresholds. Fusion threshold is dependent on sensory modalities, but, order threshold is independent on them. Experience of sequence is concerned to the order in which events occurred. As to the experience of present, he insisted that temporal intervals up to a few seconds are experienced in a way qualitatively different from longer temporal intervals. Time interval of approximately 2 sec is experienced as a unit, that is, as a present. Anticipation is concerned to temporal organization, that is, to the programming of future behavior sequences.

* * * * *

Most prevailing psychophysical functions are power functions. But, in Eisler(1976)'s review of 111 studies, the exponents range from .31 to 1.36. This wide range of exponents of the power functions which relate physical stimuli to psychological scales let the author doubt of the validity of power functions as psychophysical functions. Treisman(1964) criticized the power law from theoretical point of view, which was briefly reviewed in section B of this chapter.

Apart from the discussion which of the power law or the logarithmic law is proper one, Allan et. al(1971) proposed a constant variance model. According to their model, perception of time is essentially a linear function of physical time. But, Getty(1975) generalized Weber's law and his model succeeded in describing his data.

At present, there are two types of psychophysical functions, power or log functions, and two types of variance models,

constant variance models and Weber's law.

Reviewed in section E, time perception is also affected by nontemporal factors. Pöppel(1978) insisted that intervals longer than 2 sec are perceived in a way qualitatively different from shorter ones.

With all these varieties of theories of time perception in mind, we cannot adopt the specific model of time perception, on which a model of simple reaction time would be based. Foreperiods in a simple reaction task may include both shorter and longer than 2 sec intervals.

CHAPTER IV

A TWO-STATE MODEL

In chapter I, we saw that, for choice reaction time, the two-state (prepared and unprepared states) model by Falmagne (1965) is simple with respect to its structure and successful in describing data. For simple reaction time, we found one model, which incorporates a process of expectation/anticipation. But, this model does not predict the sequential effects, the effects of the preceding FPs.

In chapter II, the author reported experiments, which confirmed importance of expectation in simple reaction task and the effects of the preceding FP. In this chapter, the author proposed a model, which has the following three characteristics;

- 1) The model is based on the process of expectation (cf. the results of experiments I, II, III and IV).

- 2) The sequential effects are incorporated (cf. the results of experiments III and IV).

- 3) The model is described in terms of discrete states, i.e., the prepared and not-prepared states. As to the term preparedness, there are other terms, which have close relationships to it, i.e., expectation, anticipation and refractoriness. Refractoriness

frequently refers to the physiological state of being not able to respond immediately after some event. The term 'adaptation level' is used in reference to sensory processes. Expectation or anticipation refers to a process at higher level. The term 'preparedness' may be used in reference to mental or motor system. As to our two-state model, it is not important to determine to which kind of processes the term 'state' refers, physiological, sensory or conscious ones. These processes may occur simultaneously. What we should make clear is that there are two states in one of which the subject can be at a given time. But, if these states have some names, it would be better. According to Falmagne(1965)'s terminology, the term 'prepared' will be used.

As to the type of the new model, it should be qualitative. In order to make the model quantitative, we must adopt a specific psychophysical scale of time, because the anticipation is based on the perception of time. But, as reviewed in chapter III, there is no scale of time which is accepted by most investigators.

A MODEL

When we fixed a set of FPs to use, we observe that mean RTs for the various FPs differ (cf. the results of experiment I). It seems that the subject was prepared to respond for FPs with about relatively middle length. Having this in mind, the following three assumptions were proposed.

Assumption 1.

A subject is in one of two states, the prepared state (abbreviated as Sp) and the not-prepared state (abbreviated as Snp).

Assumption 2.

When the subject is in Sp (or in Snp, resp.), the distribution function of reaction time is $F_p(x)$ (or $F_{np}(x)$, resp.).

Assumption 3.

At the start of a trial, the subject is in Snp. After some time has passed, the subject enters into Sp. The distribution function of the time at which

the subject enters into Sp is D(x).

As to the exact form of Fp(x) or Fnp(x), the general-gamma distribution, eq.(4-1), was proposed by McGill and Gibbon(1965) and the Weibull distribution, eq.(4-2), by Ida(1980).

$$F(x) = 1 - \sum_{i=0}^{i=k} C_i \cdot e^{-\lambda_i \cdot x} \quad (4-1)$$

$$F(x) = 1 - e^{-\lambda \cdot (x-L)^m} \quad (4-2)$$

The general-gamma distribution is obtained when exponential distributions are summed. The gamma distribution is the special case of the general-gamma distribution in which the values of parameters of the exponential distributions are equal to each other (cf. McGill(1963)). The Weibull distribution is obtained when the conditional probability at time x that a subject who has not yet responded will come to respond, r(x), obeys the following equation;

$$r(x) = \lambda \cdot m \cdot (x - L)^{m-1}$$

In this article, the aspects of the two-state model which do not depend on the exact forms of Fp(x) and Fnp(x) are discussed. Only the relation that the mean of Fp(x) is shorter than the one of Fnp(x) is assumed.

Assumption 4 was introduced to account for the effect of the preceding FP.

Assumption 4.

$$T_0 = f(T_B, w_B, T_{pr}, w_{pr})$$

where T_{pr} is the FP in the preceding trial and T_B is determined by the background context. w_{pr} and w_B are weights for T_{pr} and T_B . That is, T_0 depends on global (T_B) and local (T_{pr}) contexts. T_0 is defined as one of parameters of $D(x)$, that is, $D(x)$ should be written as $D(x, T_0)$.

It seems evident that a subject cannot maintain his preparedness indefinitely.

Assumption 5.

After entering into Sp , the subject remains in it for a while. The distribution function of this distribution is $R(x)$.

Now, because the model proposed here is a qualitative approximation, let us make the functions, $D(x)$, $R(x)$ and $f(T_B, w_B, T_{pr}, w_{pr})$, simple ones.

Assumption 3-1.

$$D(x, T_0) = \begin{cases} 0 & x \leq T_0 \\ (x - T_0)/\delta_0 & T_0 \leq x \leq T_0 + \delta_0 \\ 1 & T_0 + \delta_0 < x \end{cases}$$

where $\delta_0 = \sigma \cdot T_0$

At this point, $D(x, T_0)$ should be written as $D(x, T_0, \delta_0)$.

See Figure 6.

Assumption 4-1.

$$\begin{aligned} T_0 &= f(T_B, w_B, T_{pr}, w_{pr}) \\ &= (w_B \cdot T_B + w_{pr} \cdot T_{pr}) / (w_B + w_{pr}) \end{aligned}$$

Assumption 5-1.

$$R(x) = \begin{cases} 0 & x \leq \rho \\ (x - \rho)/\lambda & \rho < x \leq \rho + \lambda \\ 1 & \rho + \lambda < x \end{cases}$$

At this point, $R(x)$ should be written as $R(x, \rho, \lambda)$.

See Figure 7.

With these assumptions, we can derive a distribution function of simple RT at time t , which is measured from the start of the trial. To simplify notations, some of the

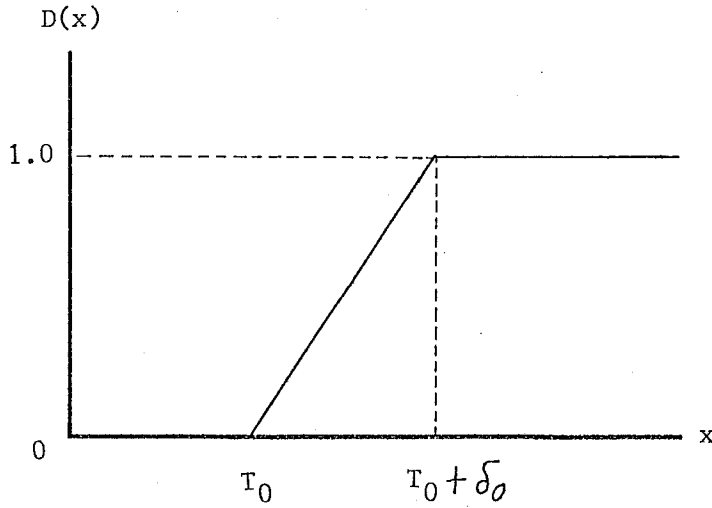


Figure 6. The distribution function, $D(x)$, of the time at which the subject enters into S_p from S_{np} .

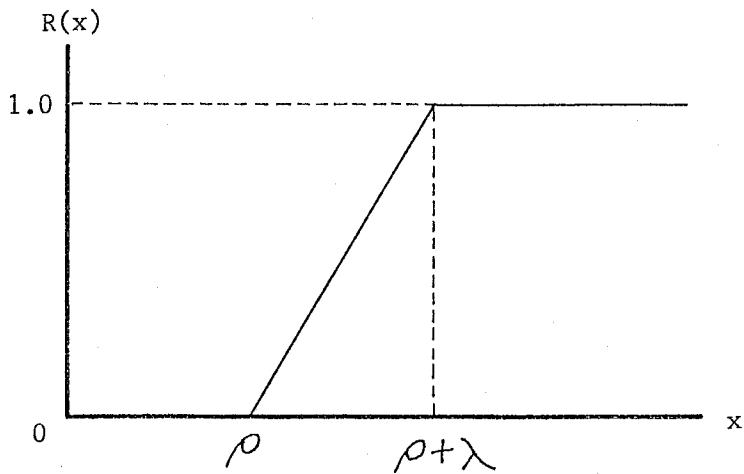


Figure 7. The distribution function, $R(x)$, of the duration for which the subject remains in S_p .

parameters of the distribution functions are suppressed, but the reader should not be confused by this notational simplification.

Let $\tilde{R}(x) = 1 - R(x)$. That is, $\tilde{R}(x)$ is the probability that the subject remains in Sp during more than x time units. Then, $\tilde{R}(t-x) \cdot dD(x)$ is the probability that the subject enters into Sp at time x and be still in Sp at time t. The probability that the subject is in Sp at time t, $P(t, T_0)$, can be expressed as follows,

$$P(t, T_0) = \int_0^t \tilde{R}(t-x) \cdot dD(x) \quad (4-3)$$

Now, let $RT(x, t, T_0)$ be the distribution function of simple RT when the stimulus is presented after time t has elapsed from the start of the trial.

Then,

$$RT(x, t, T_0) = P(t, T_0) \cdot F_p(x) + (1 - P(t, T_0)) \cdot F_{np}(x)$$

Hence, mean RT at time t, $\overline{RT}(t, T_0)$, is

$$\begin{aligned} \overline{RT}(t, T_0) &= \int_0^\infty x \cdot dRT(x, t, T_0) \\ &= P(t, T_0) \cdot \int_0^\infty x \cdot dF_p(x) + (1 - P(t, T_0)) \cdot \int_0^\infty x \cdot dF_{np}(x) \\ &= P(t, T_0) \cdot \overline{RT}_p + (1 - P(t, T_0)) \cdot \overline{RT}_{np} \end{aligned} \quad (4-4)$$

where \overline{RT}_p and \overline{RT}_{np} are the mean RTs when the subject is in Sp or in Snp, respectively.

Figure 8 shows the graph of the theoretical $\overline{RT}(t, T_0)$ for immediate FPs of 1.00, 2.00 and 3.00 as a function of Tpr value (Tpr=1.00, 1.50, 2.00, 2.50 and 3.00) when we set

$$\rho = \lambda = 2.00, \delta = 1.5, W_B = 2.0, W_{pr} = 1.0, T_B = 0.0,$$

$$\overline{RT}_p = 0.2 \text{ and } \overline{RT}_{np} = 0.3.$$

The program which was used to calculate the values in Figure 8 is given in appendix E.

Figure 9 shows the graph of the theoretical mean RTs, $\overline{RT}(t) = \text{averaged } \overline{RT}(t, T_0) \text{ over } T_0 \text{ values.}$

Inspecting the qualitative trends in Figures 8 and 9, we can conclude that the model proposed here fits qualitatively to the fact that 1) there is the optimum FP (Figure 9, also compare Figure 9 with Figures 2a and 2b), and 2) mean RTs depend on the FP in the preceding trial (Figure 8, also compare Figure 8 with Figure 5.).

MATHEMATICAL ANALYSIS

If we want to calculate the integration of eq.(4-3), we

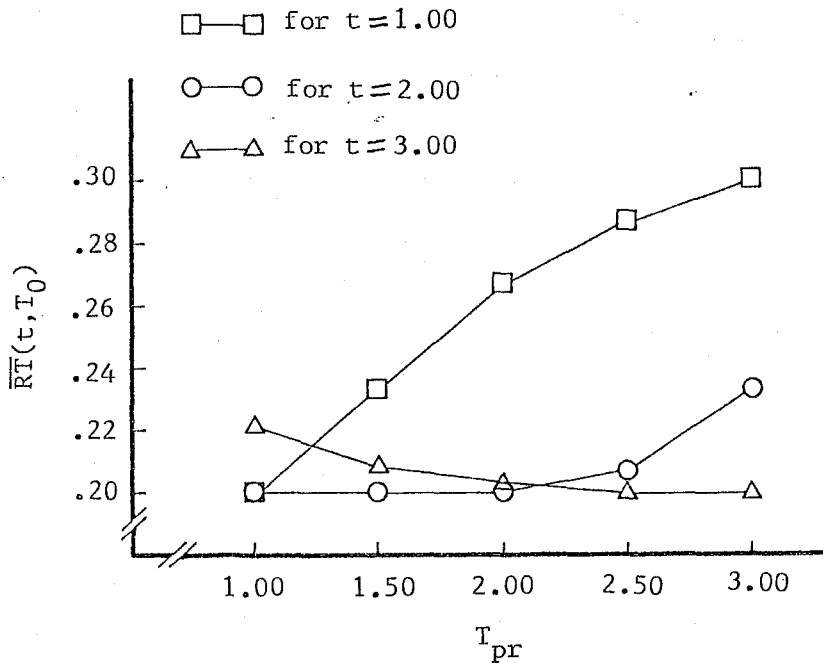


Figure 8. The theoretical mean RT for immediate FP 1.00, 2.00 and 3.00 in the psychological unit as a function of the preceding FP. The parameters were set as follows: $\rho=2.00$, $\lambda=2.00$, $\delta=1.5$, $T_B=0.0$, $W_B=2.00$, $W_{pr}=1.00$, $\overline{RT}=0.20$ and $\overline{RT}_{np}=0.30$.

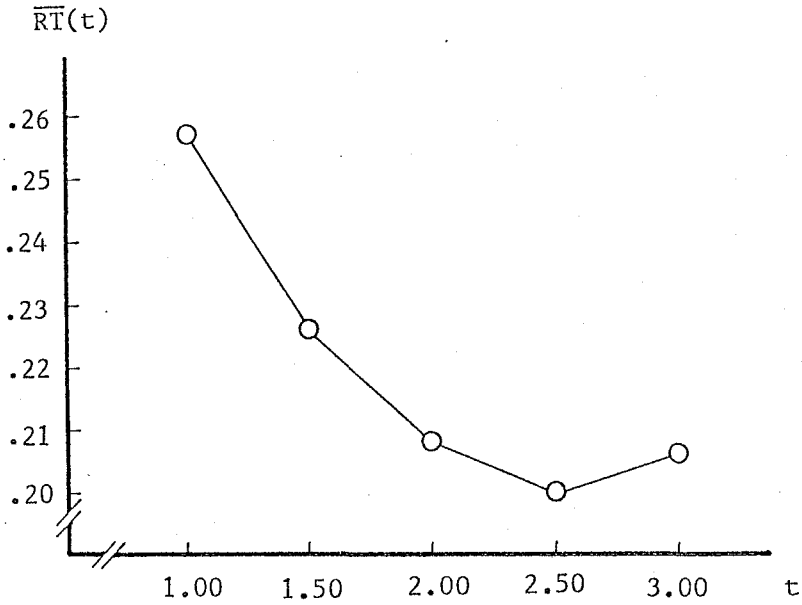


Figure 9. The theoretical mean RT as a function of immediate FP. The values of the parameters were the same as in Figure 8.

meet rather complex situation, where we must investigate many situations, each of which corresponds to each combination of the ranges of values of the parameters, T_0 , δ_0 , ρ and λ , of the functions, $D(x)$ and $R(x)$. The forms of $D(x)$ and $R(x)$ are natural approximations to the real ones. Densities of $D(x)$ and $R(x)$ are concentrated on rather restricted ranges, which are some distant from the origin 0. The forms of $D(x)$ and $R(x)$ are very simple, so the programming and calculation by computer of these functions is very easy.

But, computer calculations leave some dissatisfaction. We can see only the narrow range of the behaviors of the model which were simulated. The other part of the range of the behaviors which have not yet simulated is unknown until it is calculated.

In the following part of this chapter, in order to analyze the model mathematically, we make the forms of $D(x)$ and $R(x)$ mathematically analyzable ones.

Assumption 3-2.

$$D(x, \delta) = 1 - e^{-\delta \cdot x}$$

where δ is a decreasing function, $g(T_0)$, of T_0 .

Assumption 5-2.

$$R(x) = 1 - e^{-\rho x}$$

The assumption that δ is a decreasing function of T_0 is due to the fact that $\int_0^\infty x \cdot dD(x, \delta) = \frac{1}{\delta}$

δ is a monotonic function of T_0 and can be written as

$\delta = g(f(T_B, w_B, T_{pr}, w_{pr}))$ by assumption 4. In assumption 3-2,

$D(x, \delta)$ has δ instead of T_0 as one of the explicit parameters.

So, in the following analysis, we use δ as the parameter which depends on the FP in the preceding trial.

With assumptions 3-2 and 5-2, eq.(4-1) can be calculated as follows;

$$\begin{aligned} P(t, \delta) &= \int_0^t \tilde{R}(t-x) \cdot dD(x) \\ &= \int_0^t e^{-\rho \cdot (t-x)} \cdot \delta \cdot e^{-\delta \cdot x} dx \\ &= \delta \cdot e^{-\rho t} \cdot \int_0^t e^{(\rho-\delta) \cdot x} dx \\ &= \delta \cdot e^{-\rho t} \cdot \left[\frac{1}{(\rho-\delta)} \cdot e^{(\rho-\delta) \cdot x} \right]_0^t \\ &= \delta \cdot e^{-\rho t} \cdot \left\{ \frac{1}{(\rho-\delta)} \cdot e^{(\rho-\delta) \cdot t} - \frac{1}{(\rho-\delta)} \right\} = \frac{\delta}{\rho-\delta} (e^{-\delta t} - e^{-\rho t}) \end{aligned}$$

Hence, eq.(4-4) is given as

$$\overline{RT}(t, \delta) = P(t, \delta) \cdot \overline{RT}_p + (1 - P(t, \delta)) \cdot \overline{RT}_{np}$$

$$= \overline{RT}_{np} + (\overline{RT}_p - \overline{RT}_{np}) \cdot \frac{\delta}{\rho - \delta} \cdot (e^{-\delta \cdot t} - e^{-\rho \cdot t})$$

$$\begin{aligned} \frac{\partial \overline{RT}(t, \delta)}{\partial t} &= (\overline{RT}_p - \overline{RT}_{np}) \cdot \frac{\delta}{\rho - \delta} \cdot (-\delta \cdot e^{-\delta \cdot t} + \rho \cdot e^{-\rho \cdot t}) \\ &= (\overline{RT}_p - \overline{RT}_{np}) \cdot \frac{\rho \delta}{\rho - \delta} \cdot e^{-\rho \cdot t} \cdot (1 - \frac{\delta}{\rho} \cdot e^{(\rho - \delta) \cdot t}) \end{aligned}$$

$$\text{Let } \frac{\partial \overline{RT}(t, \delta)}{\partial t} = 0$$

Then

$$1 - \frac{\delta}{\rho} \cdot e^{(\rho - \delta) \cdot t} = 0$$

$$e^{(\rho - \delta) \cdot t} = \frac{\rho}{\delta}$$

$$t = \frac{1}{\rho - \delta} \log \frac{\rho}{\delta}$$

$$\text{Let } h(\delta) = \frac{1}{\rho - \delta} \cdot \log \frac{\rho}{\delta}$$

Then

$$\begin{aligned} \frac{dh}{d\delta} &= \frac{1}{(\rho - \delta)^2} \cdot \log \frac{\rho}{\delta} + \frac{1}{\rho - \delta} \cdot \frac{-1}{\delta} \\ &= \frac{1}{(\rho - \delta)^2} \cdot (\log \frac{\rho}{\delta} + (\rho - \delta) \cdot \frac{-1}{\delta}) \\ &= \frac{1}{(\rho - \delta)^2} \cdot (\log \frac{\rho}{\delta} - \frac{\rho}{\delta} + 1) \\ &\leq 0 \end{aligned}$$

Hence, the point, $t=h(\delta)$, at which $P(t, \delta)$ becomes minimal is a decreasing function of δ (i.e., a increasing function of T_0). This means that, when the FP in the preceding trial is larger one, then the value of T_0 is also larger (which is

implicitly assumed in assumption 4.), δ becomes smaller, and the optimum FP becomes longer. This is the sequential effect (cf. the results of experiment III).

Now, let $U(x)$ be the distribution function of δ .

Then,

$$\overline{RT}(t) = \int_0^{\infty} \overline{RT}(t, \delta) \cdot dU(\delta) \quad (4-5)$$

If $U(x)$ is a discrete distribution, eq.(4-5) can be written as,

$$\overline{RT}(t) = \sum_{i=1}^n p_i \cdot \overline{RT}(t, \delta_i) \quad (4-6)$$

where $p_i \geq 0$, $\sum_{i=1}^n p_i = 1$.

When the distribution of FPs is discrete, the distributions of T_0 and δ are also discrete by assumption.

In experiment II, six FPs were used. Consider two distributions, $\{p_i^1\}_{i=1}^6$ and $\{p_i^2\}_{i=1}^6$,

and let

$$p_1^1 = p_2^1 = p_3^1 = \frac{2}{9}, \quad p_4^1 = p_5^1 = p_6^1 = \frac{1}{9},$$

and

$$p_1^2 = p_2^2 = p_3^2 = \frac{1}{9}, \quad p_4^2 = p_5^2 = p_6^2 = \frac{2}{9}.$$

Denote $\overline{RT}(t)$'s corresponding to $\{p_i^1\}$ and $\{p_i^2\}$ as $\overline{RT}^1(t)$ and $\overline{RT}^2(t)$, respectively.

Then, by eq.(4-6),

$$\overline{RT}^1(t) = \frac{2}{9} \overline{RT}^a(t) + \frac{1}{9} \overline{RT}^b(t)$$

and

$$\overline{RT}^2(t) = \frac{1}{9} \overline{RT}^a(t) + \frac{2}{9} \overline{RT}^b(t)$$

where

$$\overline{RT}^a(t) = \overline{RT}(t, \delta_1) + \overline{RT}(t, \delta_2) + \overline{RT}(t, \delta_3)$$

and

$$\overline{RT}^b(t) = \overline{RT}(t, \delta_4) + \overline{RT}(t, \delta_5) + \overline{RT}(t, \delta_6)$$

So,

$$\overline{RT}^1(t) - \overline{RT}^2(t) = \frac{1}{9} \cdot (\overline{RT}^a(t) - \overline{RT}^b(t)) \quad (4-7)$$

When $\delta_i > \delta_j$ for $i < j$

then the value of t at which $\overline{RT}^a(t)$ becomes minimal is smaller

than the one at which $\overline{RT}^b(t)$ becomes minimal, because

$h(\delta_i) < h(\delta_j)$ for $i < j$.

Hence, eq.(4-7) means that the value of t at which $\overline{RT}^1(t)$

becomes minimal is smaller than the one at which $\overline{RT}^2(t)$ becomes

minimal. This means that the optimum FP depends on the relative

frequencies of FPs, the results of experiment II.

CHAPTER V

SUMMARY

A new model of simple reaction time was proposed in this dissertation. In order to recognize the need to propose a new model, literatures on models of choice reaction time were reviewed in the first part of chapter I and literatures on models of simple reaction time were reviewed in the following part. We found that the two-state model of choice reaction time proposed by Falmagne(1965) was simple and successful in predictions. As to models of simple reaction time, there are many models. But, only one of the models reviewed in chapter I incorporated a process of expectancy/anticipation, although the role of expectancy in simple reaction time has been emphasized by Näätänen and his collaborators (Näätänen(1970,1971), Näätänen and Merisalo(1977), Niemi and Näätänen(1981)). However, this anticipation model ignores the sequential effects.

In chapter II, the author reported four experiments, which gave the data needed to construct a new model. In experiments I and II, factors, which seemed to affect the expectancy, were manipulated. Shift of the range of FPs caused shift of the optimum FP. The optimum FP in the case where shorter FPs were

more often used was shorter than in the case where longer FPs were more often used. In experiments III and IV, the sequential effects were investigated. When the FP in the preceding trial is longer, the reaction time for short FP is longer.

To incorporate a expectation process into a quantitative model, we must adopt a specific model of time perception. Literatures on models of time perception were reviewed in chapter III, but we could not find the model which is accepted by most investigators. We must be content to construct a qualitative model.

In chapter IV, the author proposed the new model of simple reaction time which has the following characteristics;

- 1) The model is based on the process of expectation.
- 2) The sequential effects are incorporated.
- 3) The model is a two-state one.

In computer simulation, the proposed model produced the data which are similar to the data of experiments I and III. Mathematical analysis showed that the proposed model can predict the effects of the FP in the preceding trial and of the relative

frequencies of FPs.

APPENDICES

APPENDIX A

The programs for experiment I.

The program for the Short FPs condition.

EXP.A2 1

```

1:      DIMENSION CMNT(10), STTM(10), SBJNM(10), XENDTM(10),
2:      *          RTT(48), INTVLT(192), ISET1(48), ISET2(48),
3:      *          ISET3(48), ISET4(48), RTSTK1(24), RTSTK2(24)
4:      EQUIVALENCE (INTVLT(1), ISET1(1)), (INTVLT(49), ISET2(1)),
5:      *          (INTVLT(97), ISET3(1)), (INTVLT(145), ISET4(1))
6:      DATA ISET1/
7:      *      4, 1, 2, 1, 4, 5, 2, 3, 0, 5, 3, 0,
8:      *      0, 5, 1, 1, 2, 3, 2, 4, 3, 5, 4, 0,
9:      *      0, 3, 2, 3, 1, 0, 5, 4, 2, 4, 1, 5,
10:     *      0, 3, 5, 0, 1, 5, 1, 4, 2, 3, 2, 4/
11:     DATA ISET2/
12:     *      5, 2, 4, 4, 3, 1, 5, 3, 1, 0, 0, 2,
13:     *      3, 5, 4, 5, 1, 3, 2, 0, 4, 1, 0, 2,
14:     *      1, 0, 3, 3, 5, 4, 5, 4, 0, 2, 2, 1,
15:     *      3, 4, 1, 1, 0, 2, 5, 4, 3, 2, 5, 0/
16:     DATA ISET3/
17:     *      0, 2, 5, 5, 3, 3, 0, 4, 1, 4, 2, 1,
18:     *      5, 0, 2, 1, 2, 4, 5, 0, 3, 1, 3, 4,
19:     *      4, 0, 3, 4, 1, 5, 2, 3, 2, 5, 0, 1,
20:     *      5, 4, 4, 5, 2, 2, 0, 3, 1, 1, 3, 0/
21:     DATA ISET4/
22:     *      1, 4, 3, 1, 4, 2, 0, 2, 5, 3, 0, 5,
23:     *      1, 4, 1, 5, 3, 4, 0, 0, 3, 5, 2, 2,
24:     *      2, 2, 4, 3, 5, 1, 1, 5, 3, 4, 0, 0,
25:     *      5, 5, 1, 3, 4, 3, 0, 2, 2, 4, 0, 1/
26: C
27: C
28:      WRITE(2, 1010)
29: 1010  FORMAT(25(/), 'COMMENT')
30:      READ(1, 1011) CMNT
31: 1011  FORMAT(10A4)
32:      WRITE(2, 1000)
33: 1000  FORMAT(// 'START TIME')
34:      READ(1, 1001) STTM
35: 1001  FORMAT(10A4)
36:      WRITE(2, 1002)
37: 1002  FORMAT(// 'SUEJ. NAME')
38:      READ(1, 1003) SBJNM
39: 1003  FORMAT(10A4)
40:      REWIND 8
41:      DO 100 NSSN1=1, 4
42:      DO 101 NSSN2=1, 4
43:      ISSN=(NSSN1-1)*4+NSSN2
44:      WRITE(2, 2010) ISSN
45: 2010  FORMAT('SESSION', I3, 1X, 'READY?')
46:      READ(1, 2000) A
47: 2000  FORMAT(A4)
48:      CALL OUT40(1)
49: C
50: C ***** PRE-TRIAL *****
51: C
52: 200   CALL INP40(IRES)
53:      IF(IRES.EQ.0) GO TO 200.

```

EXP.A2 1

```
54:      CALL INTLTM
55:      CALL OUT40(0)
56: 230    CALL TMR(110MS,1SEC)
57:      IF(110MS.LT.50)GO TO 230
58:      DO 210 I1=1,2
59: 202    CALL TMR(110MS,1SEC)
60:      CALL INP40(IRES)
61:      IF(IRES.NE.0)GO TO 201
62:      IF(110MS.LT.200)GO TO 202
63:      CALL OUT40(1)
64:      CALL INTLTM
65: 203    CALL INP40(IRES)
66:      IF(IRES.EG.0)GO TO 203
67:      CALL OUT40(0)
68: 201    CALL INTLTM
69: 220    CALL TMR(110MS,1SEC)
70:      IF(110MS.LT.50)GO TO 220
71: 210    CONTINUE
72: C
73: C ***** MAIN TRIALS *****
74: C
75:      ISTRL=1
76: 305    ITRL=(NSSN2-1)*48+ISTRL
77:      IESI=100
78:      NCNTR=INTVLT(ITRL)
79: 311    IF(NCNTR.EQ.0)GO TO 310
80:      IRSI=IFIX(FLOAT(IRESI)*1.3)
81:      NCNTR=NCNTR-1
82:      GO TO 311
83: 310    CONTINUE
84: 301    CALL INP40(IRES)
85:      CALL TMR(110MS,1SEC)
86:      IF(IRES.NE.0)GO TO 300
87:      IF(110MS.LT.IRSI)GO TO 301
88:      GO TO 302
89: 300    RTT(ITRL)=FLOAT(110MS+1000)*0.01
90:      GO TO 303
91: 302    CALL OUT40(1)
92:      CALL INTLTM
93: 304    CALL INP40(IRES)
94:      CALL TMR(110MS,1SEC)
95:      IF(IRES.EG.0)GO TO 304
96:      RTT(ITRL)=FLOAT(110MS)*0.01
97: 303    CALL OUT40(0)
98:      CALL INTLTM
99: 500    CALL TMR(110MS,1SEC)
100:      IF(110MS.LT.50)GO TO 500
101:      ISTRL=ISTRL+1
102:      IF(ITRL.LE.48)GO TO 305
103:      WRITE(2,3300)ISSN
104: 3300    FORMAT('SESSION',13,IX,'ENDS.')
105: C
106: C ***** DATA STACK ROUTINE *****
```

EXP.A2 1

```

107: C
108:      DO 400 I11=1,24
109:      I12=I11+24
110:      RTSTK1(I11)=RTT(I11)
111:      RTSTK2(I11)=RTT(I12)
112: 400   CONTINUE
113:      WRITE(8,3000)RTSTK1
114: 3000  FORMAT(24F6.2)
115:      WRITE(8,3000)RTSTK2
116: 101   CONTINUE
117: 100   CONTINUE
118:      CALL OWARI
119:      WRITE(2,4000)
120: 4000  FORMAT(////,'ALL SESSIONS FINISHED'////
121:      *      'END TIME ?')
122:      READ(1,4001)XENDTM
123: 4001  FORMAT(10A4)
124:      WRITE(6,4002)CMNT,SEJNM,STTM,XENDTM
125: 4002  FORMAT(1H1////////5X,10A4//5X,'NAME OF THE SEJ.',10X,10A4//
126:      *      5X,'START TIME'/10X,10A4//
127:      *      5X,'END TIME'/10X,10A4)
128: C
129: C ***** PRINT OUT ROUTINE *****
130: C
131:      REWIND 8
132:      DO 600 NSSN1=1,4
133:      DO 601 NSSN2=1,4
134:      ISSN=(NSSN1-1)*4+NSSN2
135:      WRITE(6,5000)ISSN
136: 5000  FORMAT(1H1,5X,'SESSION NO. IS',I3//5X,'FOREPERIOD',
137:      *      5X,'REACTION TIME'//)
138:      READ(8,3000)RTSTK1
139:      READ(8,3000)RTSTK2
140:      DO 602 I11=1,24
141:      I12=I11+24
142:      RTT(I11)=RTSTK1(I11)
143:      RTT(I12)=RTSTK2(I11)
144: 602   CONTINUE
145:      DO 603 ISTRL=1,48
146:      ISTRL1=(NSSN2-1)*48+ISTRL
147:      IRSI=100
148:      NCNTR=INTVL1(ISTRL1)
149: 605   IF(NCNTR.EQ.0)GO TO 604
150:      IRSI=IFIX(FLOAT(IRSI)*1.3)
151:      NCNTR=NCNTR-1
152:      GO TO 605
153: 604   XIRSI=FLOAT(IRSI)*0.01
154:      WRITE(6,5001)XIRSI,RTT(ISTRL)
155: 5001  FORMAT(4X,F5.2,' SEC.',7X,F7.2,' SEC.')
156: 603   CONTINUE
157: 601   CONTINUE
158: 600   CONTINUE
159:      WRITE(6,5050)

```

EXP-A2 1

160: 5050 FORMAT(1H1//////////)
161: STOP
162: END

The program for the Long FPs condition.

EXP.A3

1

```
1:      DIMENSION CMNT(10),STTM(10),SBJNM(10),XENDTM(10),
2:      *      RTT(48),INTVLT(192),ISBT1(48),ISBT2(48),
3:      *      ISBT3(48),ISBT4(48),RTSTK1(24),RTSTK2(24)
4:      EQUIVALENCE (INTVLT(1),ISBT1(1)),(INTVLT(49),ISBT2(1)),
5:      *      (INTVLT(97),ISBT3(1)),(INTVLT(145),ISBT4(1))
6:      DATA ISBT1/
7:      *      4,1,2,1,4,5,2,3,0,5,3,0,
8:      *      0,5,1,1,2,3,2,4,3,5,4,0,
9:      *      0,3,2,3,1,0,5,4,2,4,1,5,
10:     *      0,3,5,0,1,5,1,4,2,3,2,4/
11:     DATA ISBT2/
12:     *      5,2,4,4,3,1,5,3,1,0,0,2,
13:     *      3,5,4,5,1,3,2,0,4,1,0,2,
14:     *      1,0,3,3,5,4,5,4,0,2,2,1,
15:     *      3,4,1,1,0,2,5,4,3,2,5,0/
16:     DATA ISBT3/
17:     *      0,2,5,5,3,3,0,4,1,4,2,1,
18:     *      5,0,2,1,2,4,5,0,3,1,3,4,
19:     *      4,0,3,4,1,5,2,3,2,5,0,1,
20:     *      5,4,4,5,2,2,0,3,1,1,3,0/
21:     DATA ISBT4/
22:     *      1,4,3,1,4,2,0,2,5,3,0,5,
23:     *      1,4,1,5,3,4,0,0,3,5,2,2,
24:     *      2,2,4,3,5,1,1,5,3,4,0,0,
25:     *      5,5,1,3,4,3,0,2,2,4,0,1/
26: C
27: C
28:     CALL DFFILE
29:     WRITE(2,1010)
30: 1010 FORMAT(25('/'),'COMMENT')
31:     READ(1,1011)CMNT
32: 1011 FORMAT(10A4)
33:     WRITE(2,1000)
34: 1000 FORMAT(//'START TIME')
35:     READ(1,1001)STTM
36: 1001 FORMAT(10A4)
37:     WRITE(2,1002)
38: 1002 FORMAT(//'SUBJ. NAME')
39:     READ(1,1003)SBJNM
40: 1003 FORMAT(10A4)
41:     REWIND 8
42:     DO 100 NSSN1=1,4
43:     DO 101 NSSN2=1,4
44:     ISSN=(NSSN1-1)*4+NSSN2
45:     WRITE(2,2010)ISSN
46: 2010 FORMAT('SESSION',I3,1X,'READY?')
47:     READ(1,2000)A
48: 2000 FORMAT(A4)
49:     CALL OUT40(1)
50: C
51: C ***** PRE-TRIAL *****
52: C
53: 200     CALL INP40(IRES)
```

EXP.A3 1

```
54:      IF(IRES.EQ.0)GO TO 200
55:      CALL INTLTM
56:      CALL OUT40(0)
57: 230    CALL TMR(110MS,1SEC)
58:      IF(110MS.LT.50)GO TO 230
59:      DO 210 I1=1,2
60: 202    CALL TMR(110MS,1SEC)
61:      CALL INP40(IRES)
62:      IF(IRES.NE.0)GO TO 201
63:      IF(110MS.LT.500)GO TO 202
64:      CALL OUT40(1)
65:      CALL INTLTM
66: 203    CALL INP40(IRES)
67:      IF(IRES.EQ.0)GO TO 203
68:      CALL OUT40(2)
69: 201    CALL INTLTM
70: 220    CALL TMR(110MS,1SEC)
71:      IF(110MS.LT.50)GO TO 220
72: 210    CONTINUE
73: C
74: C ***** MAIN TRIALS *****
75: C
76:      ISTRL=1
77: 305    ITRL=(NSSN2-1)*48+ISTRL
78:      IRSI=284
79:      NCNTR=INTVLT(ITRL)
80: 311    IF(NCNTR.EQ.0)GO TO 310
81:      IRSI=IFIX(FLOAT(IRSI)*1.2)
82:      NCNTR=NCNTR-1
83:      GO TO 311
84: 310    CONTINUE
85: 301    CALL INP40(IRES)
86:      CALL TMR(110MS,1SEC)
87:      IF(IRES.NE.0)GO TO 300
88:      IF(110MS.LT.IRSI)GO TO 301
89:      GO TO 302
90: 300    RTT(ITRL)=FLOAT(110MS+1000)*0.01
91:      GO TO 303
92: 302    CALL OUT40(1)
93:      CALL INTLTM
94: 304    CALL INP40(IRES)
95:      CALL TMR(110MS,1SEC)
96:      IF(IRES.EQ.0)GO TO 304
97:      RTT(ITRL)=FLOAT(110MS)*0.01
98: 303    CALL OUT40(0)
99:      CALL INTLTM
100: 500    CALL TMR(110MS,1SEC)
101:      IF(110MS.LT.50)GO TO 500
102:      ISTRL=ISTRL+1
103:      IF(ITRL.LE.48)GO TO 305
104:      WRITE(2,3300)ISSN
105: 3300    FORMAT('SESSION',I3,IX,'ENDS.')
106: C
```

EXP-A3 1

```

107: C      *****      DATA STACK ROUTINE      *****
108: C
109:      DO 400 I11=1,24
110:      I12=I11+24
111:      RTSTK1(I11)=RTT(I11)
112:      RTSTK2(I11)=RTT(I12)
113: 400 CONTINUE
114:      WRITE(8,3000)RTSTK1
115: 3000 FORMAT(24F6.2)
116:      WRITE(8,3000)RTSTK2
117: 101 CONTINUE
118: 100 CONTINUE
119:      CALL OWARI
120:      WRITE(2,4000)
121: 4000 FORMAT(////,'ALL SESSIONS FINISHED'////
122:      *      'END TIME ?')
123:      READ(1,4001)XENDTM
124: 4001 FORMAT(10A4)
125:      WRITE(6,4002)CMNT,SEJNM,STTM,XENDTM
126: 4002 FORMAT(1H1////////5X,10A4//5X,'NAME OF THE SEJ.',10X,10A4//
127:      *      5X,'START TIME'/10X,10A4//
128:      *      5X,'END TIME'/10X,10A4)
129: C
130: C      *****      PRINT OUT ROUTINE      *****
131: C
132:      REWIND 8
133:      DO 600 NSSN1=1,4
134:      DO 601 NSSN2=1,4
135:      ISSN=(NSSN1-1)*4+NSSN2
136:      WRITE(6,5000)ISSN
137: 5000 FORMAT(1H1,5X,'SESSION NO. IS',13//5X,'FOREPERIOD',
138:      *      5X,'REACTION TIME'//)
139:      READ(8,3000)RTSTK1
140:      READ(8,3000)RTSTK2
141:      DO 602 I11=1,24
142:      I12=I11+24
143:      RTT(I11)=RTSTK1(I11)
144:      RTT(I12)=RTSTK2(I11)
145: 602 CONTINUE
146:      DO 603 ISTRL=1,48
147:      ISTRL1=(NSSN2-1)*48+ISTRL
148:      IRSI=284
149:      NCNTR=INTVLT(ISTRL1)
150: 605 IF(NCNTR.EQ.0)GO TO 604
151:      IRSI=IFIX(FLOAT(IRSI)*1.2)
152:      NCNTR=NCNTR-1
153:      GO TO 605
154: 604 XIRSI=FLOAT(IRSI)*0.01
155:      WRITE(6,5001)XIRSI,RTT(ISTRL)
156: 5001 FORMAT(4X,F5.2,' SEC.',7X,F7.2,' SEC.')
157: 603 CONTINUE
158: 601 CONTINUE
159: 600 CONTINUE

```

EXP.A3 1

```
160:      WRITE(6,5050)
161: 5050  FORMAT(1H1////////////////)
162:      STOP
163:      END
```

APPENDIX B

The programs for experiment II.

The program for S-L condition.

EXP.E1 1

```

1: C
2: C      ***** MAIN PROGRAM *****
3: C
4:      DIMENSION INTVLT(400),
5:      *          I SBT1(100), I SBT2(100), I SBT3(100), I SBT4(100)
6:      EQUIVALENCE (INTVLT(1), I SBT1(1)), (INTVLT(101), I SBT2(1)),
7:      *          (INTVLT(201), I SBT3(1)), (INTVLT(301), I SBT4(1))
8:      DATA I SBT1/
9:      *      1, 2, 9, 9, 3, 8, 7, 6, 6, 3, 4, 0, 5, 4, 0, 7, 2, 5, 8, 1,
10:     *      3, 4, 7, 5, 2, 1, 7, 9, 0, 2, 6, 8, 5, 3, 9, 4, 8, 6, 1, 0,
11:     *      2, 2, 9, 6, 7, 4, 1, 5, 9, 5, 6, 8, 4, 3, 3, 1, 8, 0, 7, 0,
12:     *      9, 3, 2, 5, 7, 8, 5, 2, 0, 3, 7, 0, 8, 1, 6, 9, 6, 1, 4, 4,
13:     *      8, 1, 2, 0, 4, 6, 7, 9, 1, 3, 5, 7, 4, 6, 0, 3, 9, 2, 5, 8/
14:     DATA I SBT2/
15:     *      4, 8, 5, 6, 0, 5, 9, 7, 0, 3, 9, 7, 3, 1, 2, 4, 2, 1, 8, 6,
16:     *      8, 2, 0, 9, 3, 5, 7, 1, 9, 1, 0, 8, 2, 5, 4, 3, 4, 7, 6, 6,
17:     *      4, 7, 5, 2, 9, 6, 0, 4, 1, 8, 3, 5, 9, 6, 8, 0, 3, 7, 2, 1,
18:     *      7, 8, 0, 4, 0, 2, 6, 7, 1, 6, 5, 1, 5, 3, 8, 9, 3, 4, 2, 9,
19:     *      4, 8, 0, 5, 9, 1, 3, 6, 7, 1, 0, 6, 2, 8, 7, 5, 3, 4, 9, 2/
20:     DATA I SBT3/
21:     *      1, 7, 7, 9, 4, 6, 3, 5, 3, 0, 2, 9, 1, 2, 5, 6, 4, 0, 8, 8,
22:     *      9, 6, 8, 6, 7, 5, 0, 0, 8, 5, 4, 3, 1, 7, 4, 2, 1, 3, 2, 9,
23:     *      7, 6, 9, 3, 5, 2, 6, 9, 4, 1, 0, 8, 5, 1, 4, 7, 3, 2, 0, 8,
24:     *      1, 4, 0, 0, 6, 8, 3, 3, 5, 8, 7, 1, 2, 9, 2, 7, 4, 5, 6, 9,
25:     *      3, 0, 2, 0, 1, 6, 6, 8, 7, 1, 9, 4, 4, 9, 5, 3, 2, 5, 8, 7/
26:     DATA I SBT4/
27:     *      4, 5, 9, 3, 2, 1, 0, 6, 3, 2, 1, 4, 5, 7, 8, 9, 6, 0, 8, 7,
28:     *      1, 6, 4, 2, 3, 2, 3, 5, 0, 6, 5, 4, 0, 9, 7, 8, 1, 9, 7, 8,
29:     *      6, 4, 6, 4, 7, 8, 0, 5, 2, 3, 1, 1, 0, 9, 7, 9, 5, 8, 2, 3,
30:     *      1, 5, 7, 2, 8, 4, 7, 3, 6, 8, 0, 2, 9, 3, 1, 4, 5, 6, 0, 9,
31:     *      9, 0, 4, 0, 9, 2, 6, 7, 1, 3, 2, 4, 8, 6, 7, 3, 5, 5, 1, 8/
32: C
33: C
34:     CALL DFFILE
35:     CALL SUB1(INTVLT)
36:     CALL SUB2(INTVLT)
37:     STOP
38:     END
39: C
40: C
41: C      ***** EXPERIMENT *****
42: C
43:     SUBROUTINE SUB1(INTVLT)
44: C
45:     DIMENSION INTVLT(400), CMNT(10), STTM(10), SEJNM(10), XENDTM(10)
46:     *      RTT(100)
47:     WRITE(2, 1010)
48: 1010  FORMAT(25(/), 'COMMENT')
49:     READ(1, 1011) CMNT
50: 1011  FORMAT(10A4)
51:     WRITE(2, 1000)
52: 1000  FORMAT(// 'START TIME')
53:     READ(1, 1001) STTM

```


EXP.B1 1

```
54: 1001 FORMAT(10A4)
55:      WRITE(2,1002)
56: 1002 FORMAT(// 'SUBJ. NAME')
57:      READ(1,1003) SEJNM
58: 1003 FORMAT(10A4)
59:      REWIND 8
60:      DO 190 NSSN0=1,2
61:      DO 100 NSSN1=1,3
62:      DO 101 NSSN2=1,4
63:      ISSN=(NSSN0-1)*12+(NSSN1-1)*4+NSSN2
64:      WRITE(2,2010) ISSN
65: 2010 FORMAT('SESSION',I3,IX,'READY?')
66:      READ(1,2000) A
67: 2000 FORMAT(A4)
68:      CALL OUT40(1)
69: C
70: C ***** PRE-TRIAL *****
71: C
72: 200   CALL INP40(IRES)
73:      IF(IRES.EQ.0) GO TO 202
74:      CALL INTLTM
75:      CALL OUT40(0)
76: 230   CALL TMR(110MS,I SEC)
77:      IF(110MS.LT.50) GO TO 230
78:      DO 210 I1=1,2
79: 202   CALL TMR(110MS,I SEC)
80:      IF(110MS.LT.50) GO TO 202
81:      CALL INP40(IRES)
82:      IF(IRES.NE.0) GO TO 201
83:      IF(110MS.LT.200) GO TO 202
84:      CALL OUT40(1)
85: 203   CALL INP40(IRES)
86:      IF(IRES.EQ.0) GO TO 203
87:      CALL OUT40(0)
88: 201   CALL INTLTM
89: 210   CONTINUE
90: C
91: C ***** MAIN TRIALS *****
92: C
93:      ISTRL=1
94: 305   ITRL=(NSSN2-1)*100+ISTRL
95:      NCNTR=INTVLTL(ITRL)
96:      IF(NSSN0.EQ.1) CALL STINT1(NCNTR,IRSI)
97:      IF(NSSN0.EQ.2) CALL STINT2(NCNTR,IRSI)
98: 310   CALL TMR(110MS,I SEC)
99:      IF(110MS.LT.50) GO TO 310
100: 301   CALL INP40(IRES)
101:      CALL TMR(110MS,I SEC)
102:      IF(IRES.NE.0) GO TO 300
103:      IF(110MS.LT.IRSI) GO TO 301
104:      GO TO 302
105: 300   RTT(ISTRL)=FLOAT(110MS+1000)*0.01
106:      GO TO 303
```

EXP.B1 1

```

107: 302 CALL OUT40(1)
108:      CALL INTLTM
109: 304 CALL INF40(IRES)
110:      CALL TMR(110MS,1SEC)
111:      IF(IRES.EQ.0)GO TO 304
112:      RTT(ISTRL)=FLOAT(110MS)*0.01
113: 303 CALL OUT40(0)
114:      CALL INTLTM
115:      ISTRL=ISTRL+1
116:      IF(ISTRL.LE.100)GO TO 305
117:      WRITE(2,3300)ISSN
118: 3300 FORMAT('SESSION',I3,IX,'ENDS. ')
119: C
120: C ***** DATA STACK ROUTINE *****
121: C
122:      WRITE(8)RTT
123: 101 CONTINUE
124: 100 CONTINUE
125: 190 CONTINUE
126:      CALL OWARI
127:      WRITE(2,4000)
128: 4000 FORMAT(////, 'ALL SESSIONS FINISHED'////
129: *          'END TIME ?')
130:      READ(1,4001)XENDTM
131: 4001 FORMAT(10A4)
132:      WRITE(6,4002)CMNT,SEJNM,STTM,XENDTM
133: 4002 FORMAT(1H1////////5X,10A4//5X,'NAME OF THE SEJ.',10X,10A4//
134: *          5X,'START TIME'/10X,10A4//
135: *          5X,'END TIME'/10X,10A4)
136: C
137: C ***** PRINT OUT ROUTINE *****
138: C
139:      REWIND 8
140:      DO 690 NSSN0=1,2
141:      DO 600 NSSN1=1,3
142:      DO 601 NSSN2=1,4
143:      ISSN=(NSSN0-1)*12+(NSSN1-1)*4+NSSN2
144:      WRITE(6,5000)ISSN
145: 5000 FORMAT(1H1,5X,'SESSION NO. IS',I3//5X,'FOREPERIOD',
146: *          5X,'REACTION TIME'//)
147:      READ(8)RTT
148:      DO 603 ISTRL=1,100
149:      ISTRL1=(NSSN2-1)*100+ISTRL
150:      NCNTR=INTVL1(ISTRL1)
151:      IF(NSSN0.EQ.1)CALL STINT1(NCNTR,IRSI)
152:      IF(NSSN0.EQ.2)CALL STINT2(NCNTR,IRSI)
153:      XIRSI=FLOAT(IRSI)*0.01
154:      WRITE(6,5001)XIRSI,RTT(ISTRL)
155: 5001 FORMAT(4X,F5.2,' SEC.',7X,F7.2,' SEC.')
156: 603 CONTINUE
157: 601 CONTINUE
158: 600 CONTINUE
159: 690 CONTINUE

```

EXP.B1 1

```

160:      WRITE(6,5050)
161: 5050  FORMAT(1H1/////////)
162:      RETURN
163:      END
164: C
165: C
166: C      ***** SET INTERVAL *****
167: C
168:      SUBROUTINE STINT1(NCNTR,IRSI)
169: C
170:      IF(NCNTR*(NCNTR-1)*(NCNTR-2).EQ.0)IRSI=100
171:      IF(NCNTR.EQ.3)IRSI=130
172:      IF((NCNTR-4)*(NCNTR-5)*(NCNTR-6).EQ.0)IRSI=169
173:      IF(NCNTR.EQ.7)IRSI=219
174:      IF(NCNTR.EQ.8)IRSI=284
175:      IF(NCNTR.EQ.9)IRSI=369
176:      RETURN
177:      END
178: C
179: C
180: C      ***** SET INTERVAL *****
181: C
182:      SUBROUTINE STINT2(NCNTR,IRSI)
183: C
184:      IF(NCNTR.EQ.0)IRSI=100
185:      IF(NCNTR.EQ.1)IRSI=130
186:      IF(NCNTR.EQ.2)IRSI=169
187:      IF((NCNTR-3)*(NCNTR-4)*(NCNTR-5).EQ.0)IRSI=219
188:      IF(NCNTR.EQ.6)IRSI=284
189:      IF((NCNTR-7)*(NCNTR-8)*(NCNTR-9).EQ.0)IRSI=369
190:      RETURN
191:      END
192: C
193: C
194: C      ***** ARRANGE DATA *****
195: C
196:      SUBROUTINE SUB2(INTVLT)
197: C
198:      DIMENSION INTVLT(400),RTT(100),RRT0(10),RRT1(10),RRT2(10),
199:      *          RRT3(10),RRT4(10),RRT5(10),RRT6(10),
200:      *          RRT7(10),RRT8(10),RRT9(10)
201: C
202:      REWIND 3
203:      WRITE(6,1000)
204: 1000  FORMAT(1H1,5X,'DATA ARRANGED'////////)
205:      DO 102 ISTEP=1,2
206:      DO 100 ISTEP1=1,3
207:      DO 101 ISTEP2=1,4
208:      NSSN=(ISTEP-1)*12+(ISTEP1-1)*4+ISTEP2
209:      WRITE(6,2000)NSSN
210: 2000  FORMAT(10X,'SESSION NO. IS ',15//
211:      *      5X,'( 0 )',6X,'( 1 )',6X,'( 2 )',6X,'( 3 )',
212:      *      6X,'( 4 )',6X,'( 5 )'//

```

EXP.B1 1

```

213:      *      8X,'( 6 )',6X,'( 7 )',6X,'( 8 )',6X,'( 9 )'//)
214:      READ(8)RTT
215:      NO0=0
216:      NO1=0
217:      NO2=0
218:      NO3=0
219:      NO4=0
220:      NO5=0
221:      NO6=0
222:      NO7=0
223:      NO8=0
224:      NO9=0
225:      DO 300 I1=1,100
226:      ITRL=(ISTP2-1)*100+I1
227:      NTRCK=INTVLT(ITRL)
228:      RT=RTT(I1)
229:      IF(NTRCK.EQ.9)GO TO 390
230:      IF(NTRCK.EQ.8)GO TO 380
231:      IF(NTRCK.EQ.7)GO TO 370
232:      IF(NTRCK.EQ.6)GO TO 366
233:      IF(NTRCK.EQ.5)GO TO 350
234:      IF(NTRCK.EQ.4)GO TO 340
235:      IF(NTRCK.EQ.3)GO TO 330
236:      IF(NTRCK.EQ.2)GO TO 320
237:      IF(NTRCK.EQ.1)GO TO 310
238:      NO0=NO0+1
239:      RRT0(NO0)=RT
240:      GO TO 360
241: 390      NO9=NO9+1
242:      RRT9(NO9)=RT
243:      GO TO 360
244: 380      NO8=NO8+1
245:      RRT8(NO8)=RT
246:      GO TO 360
247: 370      NO7=NO7+1
248:      RRT7(NO7)=RT
249:      GO TO 360
250: 366      NO6=NO6+1
251:      RRT6(NO6)=RT
252:      GO TO 360
253: 350      NO5=NO5+1
254:      RRT5(NO5)=RT
255:      GO TO 360
256: 340      NO4=NO4+1
257:      RRT4(NO4)=RT
258:      GO TO 360
259: 330      NO3=NO3+1
260:      RRT3(NO3)=RT
261:      GO TO 360
262: 320      NO2=NO2+1
263:      RRT2(NO2)=RT
264:      GO TO 360
265: 310      NO1=NO1+1

```

EXP-B1 1

```
266:      RRT1(NO1)=RT
267: 360   CONTINUE
268: 300   CONTINUE
269:      DO 400 I1=1,10
270:      WRITE(6,4000)RRT0(I1),RRT1(I1),RRT2(I1),RRT3(I1),
271:      *      RRT4(I1),RRT5(I1),RRT6(I1),RRT7(I1),
272:      *      RRT8(I1),RRT9(I1)
273: 4000   FORMAT(5X,F6.2,5(6X,F6.2)/2X,4(6X,F6.2))
274: 400   CONTINUE
275:      WRITE(6,4001)
276: 4001   FORMAT(/////////)
277: 101   CONTINUE
278: 100   CONTINUE
279: 102   CONTINUE
280:      WRITE(6,4400)
281: 4400   FORMAT(1H1////////////////////)
282:      RETURN
283:      END
```

The program for L-S condition.

EXP.E2 1

```

1: C
2: C      *****  MAIN PROGRAM  *****
3: C
4:      DIMENSION  INTVLT(400),
5:      *          ISET1(100), ISET2(100), ISET3(100), ISET4(100)
6:      EQUIVALENCE (INTVLT(1), ISET1(1)), (INTVLT(101), ISET2(1)),
7:      *          (INTVLT(201), ISET3(1)), (INTVLT(301), ISET4(1))
8:      DATA  ISET1/
9:      *      1, 2, 9, 9, 3, 8, 7, 6, 6, 3, 4, 0, 5, 4, 0, 7, 2, 5, 8, 1,
10:     *      3, 4, 7, 5, 2, 1, 7, 9, 0, 2, 6, 8, 5, 3, 9, 4, 8, 6, 1, 0,
11:     *      2, 2, 9, 6, 7, 4, 1, 5, 9, 5, 6, 8, 4, 3, 3, 1, 8, 0, 7, 0,
12:     *      9, 3, 2, 5, 7, 8, 5, 2, 0, 3, 7, 0, 8, 1, 6, 9, 6, 1, 4, 4,
13:     *      8, 1, 2, 0, 4, 6, 7, 9, 1, 3, 5, 7, 4, 6, 0, 3, 9, 2, 5, 8/
14:      DATA  ISET2/
15:     *      4, 8, 5, 6, 0, 5, 9, 7, 0, 3, 9, 7, 3, 1, 2, 4, 2, 1, 8, 6,
16:     *      8, 2, 0, 9, 3, 5, 7, 1, 9, 1, 0, 8, 2, 5, 4, 3, 4, 7, 6, 6,
17:     *      4, 7, 5, 2, 9, 6, 0, 4, 1, 8, 3, 5, 9, 6, 8, 0, 3, 7, 2, 1,
18:     *      7, 8, 0, 4, 0, 2, 6, 7, 1, 6, 5, 1, 5, 3, 8, 9, 3, 4, 2, 9,
19:     *      4, 8, 0, 5, 9, 1, 3, 6, 7, 1, 0, 6, 2, 8, 7, 5, 3, 4, 9, 2/
20:      DATA  ISET3/
21:     *      1, 7, 7, 9, 4, 6, 3, 5, 3, 0, 2, 9, 1, 2, 5, 6, 4, 0, 8, 8,
22:     *      9, 6, 8, 6, 7, 5, 0, 0, 8, 5, 4, 3, 1, 7, 4, 2, 1, 3, 2, 9,
23:     *      7, 6, 9, 3, 5, 2, 6, 9, 4, 1, 0, 8, 5, 1, 4, 7, 3, 2, 0, 8,
24:     *      1, 4, 0, 0, 6, 8, 3, 3, 5, 8, 7, 1, 2, 9, 2, 7, 4, 5, 6, 9,
25:     *      3, 0, 2, 0, 1, 6, 6, 8, 7, 1, 9, 4, 4, 9, 5, 3, 2, 5, 8, 7/
26:      DATA  ISET4/
27:     *      4, 5, 9, 3, 2, 1, 0, 6, 3, 2, 1, 4, 5, 7, 8, 9, 6, 0, 8, 7,
28:     *      1, 6, 4, 2, 3, 2, 3, 5, 0, 6, 5, 4, 0, 9, 7, 8, 1, 9, 7, 8,
29:     *      6, 4, 6, 4, 7, 8, 0, 5, 2, 3, 1, 1, 0, 9, 7, 9, 5, 8, 2, 3,
30:     *      1, 5, 7, 2, 8, 4, 7, 3, 6, 8, 0, 2, 9, 3, 1, 4, 5, 6, 0, 9,
31:     *      9, 0, 4, 0, 9, 2, 6, 7, 1, 3, 2, 4, 8, 6, 7, 3, 5, 5, 1, 8/
32: C
33: C
34:      CALL DFFILE
35:      CALL SUB1(INTVLT)
36:      CALL SUB2(INTVLT)
37:      STOP
38:      END
39: C
40: C
41: C      *****  EXPERIMENT  *****
42: C
43:      SUBROUTINE SUB1(INTVLT)
44: C
45:      DIMENSION INTVLT(400), CMNT(10), STTM(10), SEJNM(10), XENDTM(10)
46:      *      RTT(100)
47:      WRITE(2, 1010)
48: 1010  FORMAT(25(/), 'COMMENT')
49:      READ(1, 1011) CMNT
50: 1011  FORMAT(10A4)
51:      WRITE(2, 1000)
52: 1000  FORMAT(// 'START TIME')
53:      READ(1, 1001) STTM

```

EXP.B2 1

```

54: 1001  FORMAT(10A4)
55:        WRITE(2,1002)
56: 1002  FORMAT(// 'SUBJ. NAME')
57:        READ(1,1003) SUBJNM
58: 1003  FORMAT(10A4)
59:        REWIND 3
60:        DO 190 NSSN0=1,2
61:        DO 100 NSSN1=1,3
62:        DO 101 NSSN2=1,4
63:        ISSN=(NSSN0-1)*12+(NSSN1-1)*4+NSSN2
64:        WRITE(2,2010) ISSN
65: 2010.  FORMAT('SESSION',I3,IX,'READY?')
66:        READ(1,2000) A
67: 2000.  FORMAT(A4)
68:        CALL OUT40(1)
69: C
70: C ***** PRE-TRIAL *****
71: C
72: 200    CALL INP40(IRES)
73:        IF(IRES.EQ.0) GO TO 200
74:        CALL INTLTM
75:        CALL OUT40(0)
76: 230    CALL TMR(110MS,1SEC)
77:        IF(110MS.LT.50) GO TO 230
78:        DO 210 I1=1,2
79: 202    CALL TMR(110MS,1SEC)
80:        IF(110MS.LT.50) GO TO 202
81:        CALL INP40(IRES)
82:        IF(IRES.NE.0) GO TO 201
83:        IF(110MS.LT.200) GO TO 202
84:        CALL OUT40(1)
85: 203    CALL INP40(IRES)
86:        IF(IRES.EQ.0) GO TO 203
87:        CALL OUT40(0)
88: 201    CALL INTLTM
89: 210    CONTINUE
90: C
91: C ***** MAIN TRIALS *****
92: C
93:        ISTRL=1
94: 305    ITRL=(NSSN2-1)*100+ISTRL
95:        NCNTR=INTVLT(ITRL)
96:        IF(NSSN0.EQ.1) CALL STINT2(NCNTR,IRSI)
97:        IF(NSSN0.EQ.2) CALL STINT1(NCNTR,IRSI)
98: 310    CALL TMR(110MS,1SEC)
99:        IF(110MS.LT.50) GO TO 310
100: 301    CALL INP40(IRES)
101:        CALL TMR(110MS,1SEC)
102:        IF(IRES.NE.0) GO TO 300
103:        IF(110MS.LT.IRSI) GO TO 301
104:        GO TO 302
105: 300    RTT(ITRL)=FLOAT(110MS+1000)*0.01
106:        GO TO 303

```


EXP-B2 1

```

107: 302 CALL OUT40(1)
108:      CALL INTLTM
109: 304 CALL INP40(IRES)
110:      CALL TMR(110MS,ISEC)
111:      IF(IRES.EC.0)GO TO 304
112:      RTT(ISTRL)=FLOAT(110MS)*0.01
113: 303 CALL OUT40(0)
114:      CALL INTLTM
115:      ISTRL=ISTRL+1
116:      IF(ISTRL.LE.100)GO TO 305
117:      WRITE(2,3300)ISSN
118: 3300 FORMAT('SESSION',I3,1X,'ENDS.')
119: C
120: C ***** DATA STACK ROUTINE *****
121: C
122:      WRITE(8)RTT
123: 101 CONTINUE
124: 100 CONTINUE
125: 190 CONTINUE
126:      CALL OWARI
127:      WRITE(2,4000)
128: 4000 FORMAT(////,'ALL SESSIONS FINISHED'////
129:      * 'END TIME ?')
130:      READ(1,4001)XENDTM
131: 4001 FORMAT(10A4)
132:      WRITE(6,4002)CMNT,SEJNM,STTM,XENDTM
133: 4002 FORMAT(1H1////////5X,10A4//5X,'NAME OF THE SEJ.',10X,10A4//
134:      * 5X,'START TIME'/10X,10A4//
135:      * 5X,'END TIME'/10X,10A4)
136: C
137: C ***** PRINT OUT ROUTINE *****
138: C
139:      REWIND 8
140:      DO 690 NSSN0=1,2
141:      DO 600 NSSN1=1,3
142:      DO 601 NSSN2=1,4
143:      ISSN=(NSSN0-1)*12+(NSSN1-1)*4+NSSN2
144:      WRITE(6,5000)ISSN
145: 5000 FORMAT(1H1,5X,'SESSION NO. IS',I3//5X,'FOREPERIOD',
146:      * 5X,'REACTION TIME'//)
147:      READ(8)RTT
148:      DO 603 ISTIL=1,100
149:      ISTIL1=(ISTIL-1)*100+1STRL
150:      NCNTR=INTVLT(ISTIL1)
151:      IF(NSSN0.EC.1)CALL STINT2(NCNTR,IRSI)
152:      IF(NSSN0.EC.2)CALL STINT1(NCNTR,IRSI)
153:      XIRSI=FLOAT(IRSI)*0.01
154:      WRITE(6,5001)XIRSI,RTT(ISTRL)
155: 5001 FORMAT(4X,F5.2,' SEC.',7X,F7.2,' SEC.')
156: 603 CONTINUE
157: 601 CONTINUE
158: 600 CONTINUE
159: 690 CONTINUE

```

EXP.B2 1

```

160:      WRITE(6,5050)
161: 5050  FORMAT(1H1/////////)
162:      RETURN
163:      END
164: C
165: C
166: C      ***** SET INTERVAL *****
167: C
168:      SUBROUTINE STINT1(NCNTR,IRSI)
169: C
170:      IF(NCNTR*(NCNTR-1)*(NCNTR-2).EQ.0)IRSI=100
171:      IF(NCNTR.EQ.3)IRSI=130
172:      IF((NCNTR-4)*(NCNTR-5)*(NCNTR-6).EQ.0)IRSI=169
173:      IF(NCNTR.EQ.7)IRSI=219
174:      IF(NCNTR.EQ.8)IRSI=284
175:      IF(NCNTR.EQ.9)IRSI=369
176:      RETURN
177:      END
178: C
179: C
180: C      ***** SET INTERVAL *****
181: C
182:      SUBROUTINE STINT2(NCNTR,IRSI)
183: C
184:      IF(NCNTR.EQ.0)IRSI=100
185:      IF(NCNTR.EQ.1)IRSI=130
186:      IF(NCNTR.EQ.2)IRSI=169
187:      IF((NCNTR-3)*(NCNTR-4)*(NCNTR-5).EQ.0)IRSI=219
188:      IF(NCNTR.EQ.6)IRSI=284
189:      IF((NCNTR-7)*(NCNTR-8)*(NCNTR-9).EQ.0)IRSI=369
190:      RETURN
191:      END
192: C
193: C
194: C      ***** ARRANGE DATA *****
195: C
196:      SUBROUTINE SUB2(INTVLT)
197: C
198:      DIMENSION INTVLT(400),RTT(100),RRT0(10),RRT1(10),RRT2(10),
199:      *          RRT3(10),RRT4(10),RRT5(10),RRT6(10),
200:      *          RRT7(10),RRT8(10),RRT9(10)
201: C
202:      REWIND 8
203:      WRITE(6,1000)
204: 1000  FORMAT(1H1,5X,'DATA ARRANGED'////////)
205:      DO 102 ISTEP=1,2
206:      DO 100 ISTEP1=1,3
207:      DO 101 ISTEP2=1,4
208:      NSSN=(ISTEP-1)*12+(ISTEP1-1)*4+ISTEP2
209:      WRITE(6,2000)NSSN
210: 2000  FORMAT(10X,'SESSION NO. IS ',15///
211:      *          5X,'( 0 )',6X,'( 1 )',6X,'( 2 )',6X,'( 3 )',
212:      *          6X,'( 4 )',6X,'( 5 )'/

```

EXP.E2 1

```

213:      *      8X,'( 6 )',6X,'( 7 )',6X,'( 8 )',6X,'( 9 )'//)
214:      READ(8)RTT
215:      NO0=0
216:      NO1=0
217:      NO2=0
218:      NO3=0
219:      NO4=0
220:      NO5=0
221:      NO6=0
222:      NO7=0
223:      NO8=0
224:      NO9=0
225:      DO 300 I1=1,100
226:      ITRL=(ISTF2-1)*100+I1
227:      NTRCK=INTVLTI(ITRL)
228:      RT=RTT(I1)
229:      IF(NTRCK.EQ.9)GO TO 390
230:      IF(NTRCK.EQ.8)GO TO 380
231:      IF(NTRCK.EQ.7)GO TO 370
232:      IF(NTRCK.EQ.6)GO TO 366
233:      IF(NTRCK.EQ.5)GO TO 350
234:      IF(NTRCK.EQ.4)GO TO 340
235:      IF(NTRCK.EQ.3)GO TO 330
236:      IF(NTRCK.EQ.2)GO TO 320
237:      IF(NTRCK.EQ.1)GO TO 310
238:      NO0=NO0+1
239:      RRT0(NO0)=RT
240:      GO TO 360
241: 390      NO9=NO9+1
242:      RRT9(NO9)=RT
243:      GO TO 360
244: 380      NO8=NO8+1
245:      RRT8(NO8)=RT
246:      GO TO 360
247: 370      NO7=NO7+1
248:      RRT7(NO7)=RT
249:      GO TO 360
250: 366      NO6=NO6+1
251:      RRT6(NO6)=RT
252:      GO TO 360
253: 350      NO5=NO5+1
254:      RRT5(NO5)=RT
255:      GO TO 360
256: 340      NO4=NO4+1
257:      RRT4(NO4)=RT
258:      GO TO 360
259: 330      NO3=NO3+1
260:      RRT3(NO3)=RT
261:      GO TO 360
262: 320      NO2=NO2+1
263:      RRT2(NO2)=RT
264:      GO TO 360
265: 310      NO1=NO1+1

```

EXP. B2 1

```
266:      RRT1(N01)=RT
267: 360   CONTINUE
268: 300   CONTINUE
269:      DO 400 I1=1,10
270:      WRITE(6,4000)RRT0(I1),RRT1(I1),RRT2(I1),RRT3(I1),
271:      *      RRT4(I1),RRT5(I1),RRT6(I1),RRT7(I1),
272:      *      RRT8(I1),RRT9(I1)
273: 4000   FORMAT(5X,F6.2,5(6X,F6.2)/2X,4(6X,F6.2))
274: 400   CONTINUE
275:      WRITE(6,4001)
276: 4001   FORMAT(/////////)
277: 101    CONTINUE
278: 100    CONTINUE
279: 102    CONTINUE
280:      WRITE(6,4400)
281: 4400   FORMAT(1H1/////////)
282:      RETURN
283:      END
```

APPENDIX C

The program for experiment III.

SRTEXP 1

```

1: C *****
2: C *
3: C *          MAIN PROGRAMM
4: C *          TO
5: C *          CONTROL
6: C *          THE SIMPLE REACTION TIME
7: C *          EXPERIMENT
8: C *
9: C *****
10: C
11: C
12: C          INSTRUMENT LAYOUT
13: C
14: C          OUT40          INP40          INP41
15: C
16: C          BIT7          LED          START          RESPONSE
17: C
18: C
19: C          DIMENSION  A1(15),A2(15),A3(15),A4(15)
20: C
21: C          CALL OUT40(0)
22: C          CALL OUT41(0)
23: C          WRITE(2,1000)
24: 1000  FORMAT('SUBJECT NAME ?')
25: C          READ(1,1100) A1
26: 1100  FORMAT(15A4)
27: C          WRITE(2,1200)
28: 1200  FORMAT('COMMENT ?')
29: C          READ(1,1100) A2
30: C          WRITE(2,1300)
31: 1300  FORMAT('START TIME ?')
32: C          READ(1,1100) A3
33: C          CALL BLK1
34: C          CALL BLK2
35: C          CALL BLK3
36: C          CALL BLK4
37: C          CALL BLK5
38: C          CALL BLK6
39: C          CALL BLK7
40: C          WRITE(2,1400)
41: 1400  FORMAT('END TIME ?')
42: C          READ(1,1100) A4
43: C          WRITE(6,2000) A2,A1,A3,A4
44: 2000  FORMAT(1H1,10(/),4(10X,15A4//))
45: C          CALL DTANL1
46: C          CALL DTANL2
47: C          CALL DTANL3
48: C          CALL DTANL4
49: C          CALL DTANL5
50: C          CALL DTANL6
51: C          CALL DTANL7
52: C          WRITE(6,3000)
53: 3000  FORMAT(1H1,10(/))

```

SRTEXP 1

```
54:      STOP
55:      END
```

SRTEXP 2

```
1:      SUBROUTINE BLK1
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,0,3,4,0,0,0,2,2,3,3,3,4,2,4,1,0,4,1,3,
4:      *      0,3,3,0,2,1,2,3,4,1,4,0,3,1,0,3,2,2,4,0,
5:      *      1,3,2,0,1,2,4,0,4,4,3,4,3,2,4,4,2,4,4,0,
6:      *      1,4,3,2,0,1,1,1,4,0,1,3,1,1,0,0,3,3,3,4,
7:      *      1,1,1,4,2,2,4,2,2,2,0,2,2,1,0,0,2,3,1,1/
8:      WRITE(2,1000)
9: 1000   FORMAT('BLOCK 1...READY ?')
10:      CALL BLK0(ISTM,XRT)
11:      CALL FL1
12:      REWIND 8
13:      WRITE(8)ISTM,XRT
14:      RETURN
15:      END
```

SRTEXP 3

```
1:      SUBROUTINE BLK2
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,1,1,0,2,0,4,4,1,3,3,1,0,1,1,3,0,1,2,3,
4:      *      2,1,2,2,3,3,3,0,2,1,4,0,4,2,2,1,4,3,2,0,
5:      *      0,4,2,1,4,4,1,3,2,0,2,1,0,3,0,4,4,2,4,3,
6:      *      2,1,1,1,0,2,4,4,3,3,1,3,3,0,0,2,1,3,4,2,
7:      *      4,1,3,4,2,3,3,1,4,2,0,2,0,4,4,0,3,4,0,0/
8:      WRITE(2,1000)
9: 1000   FORMAT('BLOCK 2...READY ?')
10:      CALL BLK0(ISTM,XRT)
11:      CALL FL2
12:      REWIND 8
13:      WRITE(8)ISTM,XRT
14:      RETURN
15:      END
```

SRTEXP 4

```
1:      SUBROUTINE BLK3
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/1,4,1,0,0,4,4,3,1,0,4,2,1,1,4,1,2,1,4,4,
4:      *      3,4,2,2,2,4,2,0,0,1,2,3,0,3,3,1,0,2,0,1,
5:      *      4,4,0,1,4,2,0,2,4,0,2,0,0,3,1,2,4,3,4,3,
6:      *      3,2,3,3,0,2,3,1,1,4,2,0,0,1,3,2,3,3,0,1,
7:      *      3,1,2,0,4,0,2,3,4,3,3,4,2,1,4,0,3,2,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 3...READY ?')
10:     CALL BLK0(ISTM,XRT)
11:     CALL FL3
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRTEXP 5

```
1:      SUBROUTINE BLK4
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,0,0,3,4,3,4,0,2,4,1,0,1,4,4,4,0,1,1,2,
4:      *      2,1,0,1,3,2,0,4,4,4,4,0,1,1,3,0,1,3,3,0,
5:      *      3,1,2,4,3,2,2,3,4,0,1,3,0,3,4,2,2,2,3,1,
6:      *      2,0,1,3,2,0,1,4,2,2,4,3,1,0,3,0,4,2,3,0,
7:      *      2,2,4,1,3,4,4,1,2,4,1,1,1,3,0,2,3,2,3,0/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 4...READY ?')
10:     CALL BLK0(ISTM,XRT)
11:     CALL FL4
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```


SRTEXP 6

```

1:      SUBROUTINE BLK5
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,4,1,0,3,1,0,0,2,2,0,1,4,2,0,0,1,0,4,2,
4:      *      3,4,1,0,3,2,3,3,0,0,1,3,4,2,1,2,4,0,4,0,
5:      *      4,3,0,3,3,4,0,4,1,3,3,2,3,2,1,1,1,0,2,2,
6:      *      2,1,1,2,1,2,3,2,4,3,3,3,1,1,1,2,2,0,2,0,
7:      *      4,4,4,3,4,0,3,0,0,1,4,1,1,2,3,2,4,4,4,4/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 5...READY ?')
10:     CALL BLK0(ISTM,XRT)
11:     CALL FL5
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END

```

SRTEXP 7

```

1:      SUBROUTINE BLK6
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/4,1,3,4,1,1,4,4,1,2,2,0,2,1,2,1,0,4,4,0,
4:      *      1,4,0,4,1,2,3,2,1,0,2,2,3,1,0,4,0,4,3,3,
5:      *      4,1,0,4,0,3,2,1,3,1,1,3,0,0,4,3,1,3,2,2,
6:      *      0,3,1,2,3,3,0,3,4,2,2,1,4,2,4,3,4,3,3,1,
7:      *      0,0,3,2,0,0,2,0,1,2,3,1,3,4,0,2,4,4,0,2/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 6...READY ?')
10:     CALL BLK0(ISTM,XRT)
11:     CALL FL6
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END

```

SRTEXP 8

```
1: SUBROUTINE BLK7
2: DIMENSION ISTM(100),XRT(100)
3: DATA ISTM/0,2,0,1,1,4,4,3,3,0,2,0,1,4,2,0,1,0,3,2,
4: *          3,3,3,3,3,2,4,3,4,0,2,1,2,4,1,0,1,3,0,2,
5: *          0,1,1,1,2,3,4,1,4,3,2,1,2,1,0,4,3,2,4,1,
6: *          2,0,0,3,3,1,3,1,0,1,4,0,0,1,2,4,3,0,4,4,
7: *          2,4,1,3,2,3,2,2,1,4,0,4,0,4,2,2,4,3,0,4/
8: WRITE(2,1000)
9: 1000 FORMAT('BLOCK 7...READY ?')
10: CALL BLK0(ISTM,XRT)
11: CALL FL7
12: REWIND 8
13: WRITE(8)ISTM,XRT
14: RETURN
15: END
```

SRTEXP 9

```
1:      SUBROUTINE BLK0(ISTM,XRT)
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      READ(1,1001)A
6: 1001  FORMAT(A4)
7: 100   CALL INP40(IRES)
8:      IF(IRES.EQ.0)GO TO 100
9:      CALL INTLTM
10: 101   CALL TMR(110MS,ISEC)
11:      IF(110MS.LT.50)GO TO 101
12:      CALL OUT40(128)
13: 102   CALL INP41(IRES)
14:      IF(IRES.EQ.0)GO TO 102
15:      CALL OUT40(0)
16:      DO 110 I1=1,2
17:      CALL INTLTM
18: 111   CALL TMR(110MS,ISEC)
19:      IF(1SEC.LT.2)GO TO 111
20:      CALL OUT40(128)
21: 112   CALL INP41(IRES)
22:      IF(IRES.EQ.0)GO TO 112
23:      CALL OUT40(0)
24: 110   CONTINUE
25:      DO 200 I2=1,100
26:      CALL INTLTM
27:      I21=ISTM(I2)
28:      ITI=100
29: 201   IF(I21.EQ.0)GO TO 211
30:      ITI=IFIX(FLOAT(ITI)*1.3)
31:      I21=I21-1
32:      GO TO 201
33: 211   CALL TMR(110MS,ISEC)
34:      IF(110MS.LT.ITI)GO TO 211
35:      CALL OUT40(128)
36:      CALL INTLTM
37: 212   CALL INP41(IRES)
38:      CALL TMR(110MS,ISEC)
39:      IF(IRES.EQ.0)GO TO 212
40:      CALL OUT40(0)
41:      XRT(I2)=FLOAT(110MS)/100.0
42: 200   CONTINUE
43:      CALL OWARI
44:      RETURN
45:      END
```

SRTEXP 10

```
1:      SUBROUTINE DTANL1
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL1
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 1'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 11

```
1:      SUBROUTINE DTANL2
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL2
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 2'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 12

```
1:      SUBROUTINE DTANL3
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL3
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 3'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 13

```
1:      SUBROUTINE DTANL4
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL4
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 4'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 14

```
1:      SUBROUTINE DTANL5
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL5
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 5'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 15

```
1:      SUBROUTINE DTANL6
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL6
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 6'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 16

```
1:      SUBROUTINE DTANL7
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL7
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 7'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRTEXP 17

```

1:      SUBROUTINE  DTANL0(ISTM,XRT)
2: C
3:      DIMENSION  ISTM(100),XRT(100),XITI(5),XTBL(5,5,10),
4:      *           JTBL(5,5),XSTM(5),XXRT(5)
5: C
6:      DO 100 I1=1,20
7:      DO 110 I11=1,5
8:      J1=(I1-1)*5+I11
9:      XXRT(I11)=XRT(J1)
10:     KSTM=100
11:     KSTP=ISTM(J1)
12: 112  IF(KSTP.EQ.0) GO TO 111
13:     KSTM=IFIX(FLOAT(KSTM)*1.3)
14:     KSTP=KSTP-1
15:     GO TO 112
16: 111  XSTM(I11)=FLOAT(KSTM)/100.0
17: 110  CONTINUE
18:     WRITE(6,1100)(XSTM(J1),XXRT(J1),J1=1,5)
19: 1100  FORMAT(1X,5(F5.2,F6.2,3X))
20: 100  CONTINUE
21: C
22: C
23:     DO 200 I2=1,5
24:     DO 201 I21=1,5
25:     DO 202 I22=1,10
26:     XTBL(I2,I21,I22)=99999.9
27: 202  CONTINUE
28:     JTBL(I2,I21)=0
29: 201  CONTINUE
30: 200  CONTINUE
31:     K2=ISTM(I)+1
32:     DO 210 I2=2,100
33:     K1=K2
34:     K2=ISTM(I2)+1
35:     JTBL(K1,K2)=JTBL(K1,K2)+1
36:     K3=JTBL(K1,K2)
37:     XTBL(K1,K2,K3)=XRT(I2)
38: 210  CONTINUE
39:     KITI=100
40:     DO 300 I3=1,5
41:     XITI(I3)=FLOAT(KITI)/100.0
42:     KITI=IFIX(FLOAT(KITI)*1.3)
43: 300  CONTINUE
44:     WRITE(6,2000)
45: 2000  FORMAT(1H1,5X,'CONTINGENCY TABLES')
46:     DO 400 I4=1,5
47:     WRITE(6,2100)XITI(I4),(XITI(J4),J4=1,5)
48: 2100  FORMAT(///15X,'RT'S FOR',F5.2,1X,'SEC. FP'//
49:      *        12X,'CONTINGENT ON PREVIOUS FP'S.'//
50:      *        10X,5(F5.2,' SEC. ')//)
51:     WRITE(6,2200)((XTBL(JK1,I4,JK2),JK1=1,5),JK2=1,10)
52: 2200  FORMAT(10(10X,5(F5.2,5X),/))
53: 400  CONTINUE

```

SRTEXP 17

54: C

55: C

56: RETURN

57: END

APPENDIX D

The programs for experiment IV.

The program for the continuous(in session 1)-
then-discrete(in session 2) condition.

SRT.C.D 1

```

1: C *****
2: C *
3: C *
4: C *          MAIN PROGRAMM          *
5: C *          TO                      *
6: C *          CONTROL                  *
7: C *          THE SIMPLE REACTION TIME *
8: C *          EXPERIMENT                *
9: C *          (CONTINUOUS-DISCRETE CONTEXT) *
10: C *****
11: C
12: C
13: C          INSTRUMENT LAYOUT
14: C
15: C          OUT40          OUT41          INP40          INP41
16: C
17: C          BIT7          LED          BUZZER          START          RESPONSE
18: C
19: C
20: C          DIMENSION  A1(15),A3(15),A4(15)
21: C
22: C          CALL OUT40(0)
23: C          CALL OUT41(0)
24: C          WRITE(2,1200)
25: C          1200  FORMAT(///'CONTINUOUS-DISCRETE CONTEXT CONDITION. '///)
26: C          WRITE(2,1000)
27: C          1000  FORMAT('SUBJECT NAME ? ')
28: C          READ(1,1100)A1
29: C          1100  FORMAT(15A4)
30: C          WRITE(2,1300)
31: C          1300  FORMAT('START TIME ? ')
32: C          READ(1,1100)A3
33: C          CALL BLK1C
34: C          CALL BLK2C
35: C          CALL BLK3C
36: C          CALL BLK4C
37: C          CALL BLK5C
38: C          WRITE(2,4000)
39: C          4000  FORMAT(///'CONTEXT WILL CHANGE. '//
40: C          *          'ATTENTION PLEASE !'///)
41: C          CALL BLK6D
42: C          CALL BLK7D
43: C          CALL BLK8D
44: C          CALL BLK9D
45: C          CALL BLKAD
46: C          WRITE(2,1400)
47: C          1400  FORMAT('END TIME ? ')
48: C          READ(1,1100)A4
49: C          WRITE(6,2000)A1,A3,A4
50: C          2000  FORMAT(1H1,10(/),10X,
51: C          *          '**** CONTINUOUS-DISCRETE CONTEXT ****'
52: C          *          ///,3(10X,15A4///))
53: C          CALL DTANL1

```

SRT.C.D 1

```
54:      CALL DTANL2
55:      CALL DTANL3
56:      CALL DTANL4
57:      CALL DTANL5
58:      CALL DTANL6
59:      CALL DTANL7
60:      CALL DTANL8
61:      CALL DTANL9
62:      CALL DTANLA
63:      WRITE(6,3000)
64: 3000  FORMAT(1H1,10(/))
65:      STOP
66:      END
```

SRT.C.D 2

```
1:      SUBROUTINE BLK1C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,0,3,4,0,0,0,2,2,3,3,3,4,2,4,1,0,4,1,3,
4:      *      0,3,3,0,2,1,2,3,4,1,4,0,3,1,0,3,2,2,4,0,
5:      *      1,3,2,0,1,2,4,0,4,4,3,4,3,2,4,4,2,4,4,0,
6:      *      1,4,3,2,0,1,1,1,4,0,1,3,1,1,0,0,3,3,3,4,
7:      *      1,1,1,4,2,2,4,2,2,2,0,2,2,1,0,0,2,3,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 1...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL1
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 3

```
1:      SUBROUTINE BLK2C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,1,1,0,2,0,4,4,1,3,3,1,0,1,1,3,0,1,2,3,
4:      *      2,1,2,2,3,3,3,0,2,1,4,0,4,2,2,1,4,3,2,0,
5:      *      0,4,2,1,4,4,1,3,2,0,2,1,0,3,0,4,4,2,4,3,
6:      *      2,1,1,1,0,2,4,4,3,3,1,3,3,0,0,2,1,3,4,2,
7:      *      4,1,3,4,2,3,3,1,4,2,0,2,0,4,4,0,3,4,0,0/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 2...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL2
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 4

```
1:      SUBROUTINE BLK3C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/1,4,1,0,0,4,4,3,1,0,4,2,1,1,4,1,2,1,4,4,
4:      *          3,4,2,2,2,4,2,0,0,1,2,3,0,3,3,1,0,2,0,1,
5:      *          4,4,0,1,4,2,0,2,4,0,2,0,0,3,1,2,4,3,4,3,
6:      *          3,2,3,3,0,2,3,1,1,4,2,0,0,1,3,2,3,3,0,1,
7:      *          3,1,2,0,4,0,2,3,4,3,3,4,2,1,4,0,3,2,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 3...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL3
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 5

```
1:      SUBROUTINE BLK4C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,0,0,3,4,3,4,0,2,4,1,0,1,4,4,4,0,1,1,2,
4:      *          2,1,0,1,3,2,0,4,4,4,4,0,1,1,3,0,1,3,3,0,
5:      *          3,1,2,4,3,2,2,3,4,0,1,3,0,3,4,2,2,2,3,1,
6:      *          2,0,1,3,2,0,1,4,2,2,4,3,1,0,3,0,4,2,3,0,
7:      *          2,2,4,1,3,4,4,1,2,4,1,1,1,3,0,2,3,2,3,0/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 4...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL4
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 6

```
1:      SUBROUTINE BLK5C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,4,1,0,3,1,0,0,2,2,0,1,4,2,0,0,1,0,4,2,
4:      *      3,4,1,0,3,2,3,3,0,0,1,3,4,2,1,2,4,0,4,0,
5:      *      4,3,0,3,3,4,0,4,1,3,3,2,3,2,1,1,1,0,2,2,
6:      *      2,1,1,2,1,2,3,2,4,3,3,3,1,1,1,2,2,0,2,0,
7:      *      4,4,4,3,4,0,3,0,0,1,4,1,1,2,3,2,4,4,4,4/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 5...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL5
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 7

```
1:      SUBROUTINE BLK6D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/4,1,3,4,1,1,4,4,1,2,2,0,2,1,2,1,0,4,4,0,
4:      *      1,4,0,4,1,2,3,2,1,0,2,2,3,1,0,4,0,4,3,3,
5:      *      4,1,0,4,0,3,2,1,3,1,1,3,0,0,4,3,1,3,2,2,
6:      *      0,3,1,2,3,3,0,3,4,2,2,1,4,2,4,3,4,3,3,1,
7:      *      0,0,3,2,0,0,2,0,1,2,3,1,3,4,0,2,4,4,0,2/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 6...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL6
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 8

```
1:      SUBROUTINE BLK7D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,2,0,1,1,4,4,3,3,0,2,0,1,4,2,0,1,0,3,2,
4:      *      3,3,3,3,3,2,4,3,4,0,2,1,2,4,1,0,1,3,0,2,
5:      *      0,1,1,1,2,3,4,1,4,3,2,1,2,1,0,4,3,2,4,1,
6:      *      2,0,0,3,3,1,3,1,0,1,4,0,0,1,2,4,3,0,4,4,
7:      *      2,4,1,3,2,3,2,2,1,4,0,4,0,4,2,2,4,3,0,4/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 7...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL7
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 9

```
1:      SUBROUTINE BLK8D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/2,4,2,4,2,1,1,2,4,4,2,2,1,0,2,0,1,3,3,0,
4:      *      4,0,3,2,4,2,2,3,4,1,4,1,1,0,1,3,1,3,0,1,
5:      *      2,3,2,1,4,0,2,1,3,3,1,2,4,4,1,2,4,0,4,1,
6:      *      0,4,4,1,3,4,0,1,3,0,0,3,0,0,3,0,2,4,3,1,
7:      *      2,3,0,2,1,0,2,2,0,3,4,3,1,4,3,4,0,0,3,3/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 8...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL8
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```


SRT.C.D 10

```
1:      SUBROUTINE BLK9D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/1,3,2,1,4,3,4,4,1,4,4,3,4,0,0,1,3,4,2,2,
4:      *      3,0,2,4,0,0,1,1,3,3,4,4,0,3,1,0,0,4,0,0,
5:      *      2,3,2,3,0,2,4,4,2,2,4,0,2,1,2,3,2,0,1,1,
6:      *      1,3,1,1,1,2,2,0,4,0,0,1,1,4,4,1,0,3,2,2,
7:      *      2,3,0,3,1,3,3,1,4,1,0,0,2,3,2,3,4,3,4,2/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 9...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL9
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 11

```
1:      SUBROUTINE BLKAD
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,1,4,2,3,4,4,4,1,0,0,2,0,3,0,2,0,2,1,3,
4:      *      0,0,3,1,1,0,4,4,0,1,2,2,4,2,3,0,0,3,0,4,
5:      *      3,1,2,4,0,3,4,4,2,0,2,1,3,1,1,3,0,3,1,1,
6:      *      0,4,4,2,0,2,3,4,4,1,0,2,0,4,4,4,2,2,2,3,
7:      *      3,2,3,2,1,3,1,4,1,4,1,3,2,1,3,0,3,2,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 10...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FLA
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.C.D 12

```
1:      SUBROUTINE  BLK0C(ISTM,XRT)
2:  C
3:      DIMENSION  ISTM(100),XRT(100)
4:  C
5:      READ(1,1001)A
6: 1001  FORMAT(A4)
7: 100   CALL INP40(IRES)
8:      IF(IRES.EQ.0)GO TO 100
9:      CALL INTLTM
10: 101   CALL TMR(110MS,1SEC)
11:      IF(110MS.LT.50)GO TO 101
12:      CALL OUT40(128)
13: 102   CALL INP41(IRES)
14:      IF(IRES.EQ.0)GO TO 102
15:      CALL OUT40(0)
16:      DO 110 I1=1,2
17:      CALL INTLTM
18: 111   CALL TMR(110MS,1SEC)
19:      IF(1SEC.LT.2)GO TO 111
20:      CALL OUT40(128)
21: 112   CALL INP41(IRES)
22:      IF(IRES.EQ.0)GO TO 112
23:      CALL OUT40(0)
24: 110   CONTINUE
25:      DO 200 I2=1,100
26:      CALL INTLTM
27:      I21=ISTM(I2)
28:      ITI=100
29: 201   IF(I21.EQ.0)GO TO 211
30:      ITI=IFIX(FLOAT(ITI)*1.3)
31:      I21=I21-1
32:      GO TO 201
33: 211   CALL TMR(110MS,1SEC)
34:      IF(110MS.LT.ITI)GO TO 211
35:      CALL OUT40(128)
36:      CALL INTLTM
37: 212   CALL INP41(IRES)
38:      CALL TMR(110MS,1SEC)
39:      IF(IRES.EQ.0)GO TO 212
40:      CALL OUT40(0)
41:      XRT(I2)=FLOAT(110MS)/100.0
42: 200   CONTINUE
43:      CALL OWARI
44:      RETURN
45:      END
```

SRT.C.D 13

```
1:      SUBROUTINE  BLKØD(ISTM,XRT)
2:  C
3:      DIMENSION ISTM(100),XRT(100)
4:  C
5:      READ(1,1001)A
6: 1001  FORMAT(A4)
7:      DO 110 I1=1,2
8:      CALL BUZZER
9:      CALL INTLTM
10: 111  CALL TMR(110MS,I SEC)
11:      IF(I SEC.LT.2)GO TO 111
12:      CALL OUT40(128)
13: 112  CALL INP41(IRES)
14:      IF(IRES.EQ.Ø)GO TO 112
15:      CALL OUT40(Ø)
16: 110  CONTINUE
17:      DO 200 I2=1,100
18:      CALL BUZZER
19:      CALL INTLTM
20:      I21=ISTM(I2)
21:      ITI=100
22: 201  IF(I21.EQ.Ø)GO TO 211
23:      ITI=IFIX(FLOAT(ITI)*1.3)
24:      I21=I21-1
25:      GO TO 201
26: 211  CALL TMR(110MS,I SEC)
27:      IF(110MS.LT.ITI)GO TO 211
28:      CALL OUT40(128)
29:      CALL INTLTM
30: 212  CALL INP41(IRES)
31:      CALL TMR(110MS,I SEC)
32:      IF(IRES.EQ.Ø)GO TO 212
33:      CALL OUT40(Ø)
34:      XRT(I2)=FLOAT(110MS)/100.0
35: 200  CONTINUE
36:      CALL OWARI
37:      RETURN
38:      END
```

SRT.C.D 14

```
1:      SUBROUTINE BUZZER
2:      CALL INTLTM
3: 300    CALL TMR(110MS,I SEC)
4:      CALL INP40(IRES)
5:      IF(IRES.NE.0)GO TO 400
6:      IF(110MS.LT.50)GO TO 300
7:      CALL INTLTM
8:      CALL OUT41(128)
9: 100    CALL TMR(110MS,I SEC)
10:     CALL INP40(IRES)
11:     IF(IRES.NE.0)GO TO 400
12:     IF(110MS.LT.20)GO TO 100
13: 420    CALL OUT41(0)
14:     CALL INTLTM
15: 500    CALL TMR(110MS,I SEC)
16:     CALL INP40(IRES)
17:     IF(IRES.NE.0)GO TO 400
18:     IF(110MS.LT.10)GO TO 500
19: 200    CALL INP40(IRES)
20:     IF(IRES.EQ.0)GO TO 200
21:     RETURN
22: C
23: 400    CALL INP40(IRES)
24:     CALL OUT41(128)
25:     IF(IRES.NE.0)GO TO 400
26:     CALL INTLTM
27: 410    CALL TMR(110MS,I SEC)
28:     IF(I SEC.LT.5)GO TO 410
29:     GO TO 420
30: C
31:      END
```

SRT.C.D 15

```
1:      SUBROUTINE DTANL1
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL1
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 1'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 16

```
1:      SUBROUTINE DTANL2
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL2
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 2'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 17

```
1:      SUBROUTINE DTANL3
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL3
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 3'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 13

```
1:      SUBROUTINE DTANL4
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL4
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 4'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 19

```
1:      SUBROUTINE DTANL5
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL5
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 5'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 20

```
1:      SUBROUTINE DTANL6
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL6
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 6'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 21

```
1:      SUBROUTINE  DTANL7
2: C
3:      DIMENSION  ISTM(100),XRT(100)
4: C
5:      CALL FL7
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 7'///
10:      *          1X,5('ITI  RT(SEC)  '),///)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 22

```
1:      SUBROUTINE  DTANL8
2: C
3:      DIMENSION  ISTM(100),XRT(100)
4: C
5:      CALL FL8
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 8'///
10:      *          1X,5('ITI  RT(SEC)  '),///)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 23

```
1:      SUBROUTINE  DTANL9
2: C
3:      DIMENSION  ISTM(100),XRT(100)
4: C
5:      CALL FL9
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 9'///
10:      *          1X,5('ITI  RT(SEC)  '),///)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.C.D 24

```
1:      SUBROUTINE DTANLA
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FLA
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 10'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```


SRT.C.D 25

```
1:      SUBROUTINE  DTANL0(ISTM,XRT)
2:  C
3:      DIMENSION  ISTM(100),XRT(100),XITI(5),XTBL(5,5,10),
4:      *           JTBL(5,5),XSTM(5),XXRT(5)
5:  C
6:      DO 100 I1=1,20
7:      DO 110 I11=1,5
8:      J1=(I1-1)*5+I11
9:      XXRT(I11)=XRT(J1)
10:     KSTM=100
11:     KSTP=ISTM(J1)
12: 112  IF(KSTP.EQ.0)GO TO 111
13:     KSTM=IFIX(FLOAT(KSTM)*1.3)
14:     KSTP=KSTP-1
15:     GO TO 112
16: 111  XSTM(I11)=FLOAT(KSTM)/100.0
17: 110  CONTINUE
18:     WRITE(6,1100)(XSTM(J1),XXRT(J1),J1=1,5)
19: 1100  FORMAT(1X,5(F5.2,F6.2,3X))
20: 100  CONTINUE
21:  C
22:  C
23:     DO 200 I2=1,5
24:     DO 201 I21=1,5
25:     DO 202 I22=1,10
26:     XTBL(I2,I21,I22)=99999.9
27: 202  CONTINUE
28:     JTBL(I2,I21)=0
29: 201  CONTINUE
30: 200  CONTINUE
31:     K2=ISTM(1)+1
32:     DO 210 I2=2,100
33:     K1=K2
34:     K2=ISTM(I2)+1
35:     JTBL(K1,K2)=JTBL(K1,K2)+1
36:     K3=JTBL(K1,K2)
37:     XTBL(K1,K2,K3)=XRT(I2)
38: 210  CONTINUE
39:     KITI=100
40:     DO 300 I3=1,5
41:     XITI(I3)=FLOAT(KITI)/100.0
42:     KITI=IFIX(FLOAT(KITI)*1.3)
43: 300  CONTINUE
44:     WRITE(6,2000)
45: 2000  FORMAT(1H1,5X,'CONTINGENCY TABLES')
46:     DO 400 I4=1,5
47:     WRITE(6,2100)XITI(I4),(XITI(J4),J4=1,5)
48: 2100  FORMAT(///15X,'RT'S FOR',F5.2,1X,'SEC. FP'//
49:      *      12X,'CONTINGENT ON PREVIOUS FP'S. '//
50:      *      10X,5(F5.2,' SEC. ')//)
51:     WRITE(6,2200)((XTBL(JK1,I4,JK2),JK1=1,5),JK2=1,10)
52: 2200  FORMAT(10(10X,5(F5.2,5X),/))
53: 400  CONTINUE
```

SRT.C.D 25

54: C

55: C

56: RETURN

57: END

The program for the discrete(in session 1)-
then-continuous(in session 2) condition.

SRT.D.C 1

```

1: C *****
2: C *
3: C *
4: C *          MAIN PROGRAMM          *
5: C *          TO                      *
6: C *          CONTROL                 *
7: C *          THE SIMPLE REACTION TIME *
8: C *          EXPERIMENT              *
9: C *          (DISCRETE-CONTINUOUS CONTEXT) *
10: C *****
11: C
12: C
13: C          INSTRUMENT LAYOUT
14: C
15: C          OUT40      OUT41      INP40      INP41
16: C
17: C          BIT7      LED      BUZZER      START      RESPONSE
18: C
19: C
20: C          DIMENSION  A1(15), A3(15), A4(15)
21: C
22: C          CALL OUT40(0)
23: C          CALL OUT41(0)
24: C          WRITE(2,1200)
25: C 1200  FORMAT(// 'DISCRETE-CONTINUOUS CONTEXT CONDITION. '///)
26: C          WRITE(2,1000)
27: C 1000  FORMAT('SUEJECT NAME ? ')
28: C          READ(1,1100) A1
29: C 1100  FORMAT(15A4)
30: C          WRITE(2,1300)
31: C 1300  FORMAT('START TIME ? ')
32: C          READ(1,1100) A3
33: C          CALL BLK1D
34: C          CALL BLK2D
35: C          CALL BLK3D
36: C          CALL BLK4D
37: C          CALL BLK5D
38: C          WRITE(2,4000)
39: C 4000  FORMAT(/// 'CONTEXT WILL CHANGE. '///
40: C *      'ATTENTION PLEASE !'///)
41: C          CALL BLK6C
42: C          CALL BLK7C
43: C          CALL BLK8C
44: C          CALL BLK9C
45: C          CALL BLKAC
46: C          WRITE(2,1400)
47: C 1400  FORMAT('END TIME ? ')
48: C          READ(1,1100) A4
49: C          WRITE(6,2000) A1, A3, A4
50: C 2000  FORMAT(1H1, 10(/), 10X,
51: C *      '***** DISCRETE-CONTINUOUS CONTEXT *****'
52: C *      ///, 3(10X, 15A4///))
53: C          CALL DTANL1

```

SRT.D.C 1

```
54:      CALL DTANL2
55:      CALL DTANL3
56:      CALL DTANL4
57:      CALL DTANL5
58:      CALL DTANL6
59:      CALL DTANL7
60:      CALL DTANL8
61:      CALL DTANL9
62:      CALL DTANLA
63:      WRITE(6,3000)
64: 3000  FORMAT(1H1,10(/))
65:      STOP
66:      END
```

SRT.D.C 2

```
1:      SUBROUTINE BLK1D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,0,3,4,0,0,0,2,2,3,3,3,4,2,4,1,0,4,1,3,
4:      *      0,3,3,0,2,1,2,3,4,1,4,0,3,1,0,3,2,2,4,0,
5:      *      1,3,2,0,1,2,4,0,4,4,3,4,3,2,4,4,2,4,4,0,
6:      *      1,4,3,2,0,1,1,1,4,0,1,3,1,1,0,0,3,3,3,4,
7:      *      1,1,1,4,2,2,4,2,2,0,2,2,1,0,0,2,3,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 1...READY ?')
10:      CALL BLK0D(ISTM,XRT)
11:      CALL FL1
12:      REWIND 8
13:      WRITE(8)ISTM,XRT
14:      RETURN
15:      END
```

SRT.D.C 3

```
1:      SUBROUTINE BLK2D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,1,1,0,2,0,4,4,1,3,3,1,0,1,1,3,0,1,2,3,
4:      *      2,1,2,2,3,3,3,0,2,1,4,0,4,2,2,1,4,3,2,0,
5:      *      0,4,2,1,4,4,1,3,2,0,2,1,0,3,0,4,4,2,4,3,
6:      *      2,1,1,1,0,2,4,4,3,3,1,3,3,0,0,2,1,3,4,2,
7:      *      4,1,3,4,2,3,3,1,4,2,0,2,0,4,4,0,3,4,0,0/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 2...READY ?')
10:      CALL BLK0D(ISTM,XRT)
11:      CALL FL2
12:      REWIND 8
13:      WRITE(8)ISTM,XRT
14:      RETURN
15:      END
```

SRT.D.C 4

```
1:      SUBROUTINE BLK3D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/1,4,1,0,0,4,4,3,1,0,4,2,1,1,4,1,2,1,4,4,
4:      *      3,4,2,2,2,4,2,0,0,1,2,3,0,3,3,1,0,2,0,1,
5:      *      4,4,0,1,4,2,0,2,4,0,2,0,0,3,1,2,4,3,4,3,
6:      *      3,2,3,3,0,2,3,1,1,4,2,0,0,1,3,2,3,3,0,1,
7:      *      3,1,2,0,4,0,2,3,4,3,3,4,2,1,4,0,3,2,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 3...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL3
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.D.C 5

```
1:      SUBROUTINE BLK4D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,0,0,3,4,3,4,0,2,4,1,0,1,4,4,4,0,1,1,2,
4:      *      2,1,0,1,3,2,0,4,4,4,4,0,1,1,3,0,1,3,3,0,
5:      *      3,1,2,4,3,2,2,3,4,0,1,3,0,3,4,2,2,2,3,1,
6:      *      2,0,1,3,2,0,1,4,2,2,4,3,1,0,3,0,4,2,3,0,
7:      *      2,2,4,1,3,4,4,1,2,4,1,1,1,3,0,2,3,2,3,0/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 4...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL4
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.D.C 6

```
1:      SUBROUTINE BLK5D
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,4,1,0,3,1,0,0,2,2,0,1,4,2,0,0,1,0,4,2,
4:      *      3,4,1,0,3,2,3,3,0,0,1,3,4,2,1,2,4,0,4,0,
5:      *      4,3,0,3,3,4,0,4,1,3,3,2,3,2,1,1,1,0,2,2,
6:      *      2,1,1,2,1,2,3,2,4,3,3,3,1,1,1,2,2,0,2,0,
7:      *      4,4,4,3,4,0,3,0,0,1,4,1,1,2,3,2,4,4,4,4/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 5...READY ?')
10:     CALL BLK0D(ISTM,XRT)
11:     CALL FL5
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.D.C 7

```
1:      SUBROUTINE BLK6C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/4,1,3,4,1,1,4,4,1,2,2,0,2,1,2,1,0,4,4,0,
4:      *      1,4,0,4,1,2,3,2,1,0,2,2,3,1,0,4,0,4,3,3,
5:      *      4,1,0,4,0,3,2,1,3,1,1,3,0,0,4,3,1,3,2,2,
6:      *      0,3,1,2,3,3,0,3,4,2,2,1,4,2,4,3,4,3,3,1,
7:      *      0,0,3,2,0,0,2,0,1,2,3,1,3,4,0,2,4,4,0,2/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 6...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL6
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```


SRT.D.C 8

```

1:      SUBROUTINE BLK7C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/0,2,0,1,1,4,4,3,3,0,2,0,1,4,2,0,1,0,3,2,
4:      *      3,3,3,3,3,2,4,3,4,0,2,1,2,4,1,0,1,3,0,2,
5:      *      0,1,1,1,2,3,4,1,4,3,2,1,2,1,0,4,3,2,4,1,
6:      *      2,0,0,3,3,1,3,1,0,1,4,0,0,1,2,4,3,0,4,4,
7:      *      2,4,1,3,2,3,2,2,1,4,0,4,0,4,2,2,4,3,0,4/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 7...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL7
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END

```

SRT.D.C 9

```

1:      SUBROUTINE BLK8C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/2,4,2,4,2,1,1,2,4,4,2,2,1,0,2,0,1,3,3,0,
4:      *      4,0,3,2,4,2,2,3,4,1,4,1,1,0,1,3,1,3,0,1,
5:      *      2,3,2,1,4,0,2,1,3,3,1,2,4,4,1,2,4,0,4,1,
6:      *      0,4,4,1,3,4,0,1,3,0,0,3,0,0,3,0,2,4,3,1,
7:      *      2,3,0,2,1,0,2,2,0,3,4,3,1,4,3,4,0,0,3,3/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 8...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL8
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END

```

SRT.D.C 10

```
1:      SUBROUTINE BLK9C
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/1,3,2,1,4,3,4,4,1,4,4,3,4,0,0,1,3,4,2,2,
4:      *      3,0,2,4,0,0,1,1,3,3,4,4,0,3,1,0,0,4,0,0,
5:      *      2,3,2,3,0,2,4,4,2,2,4,0,2,1,2,3,2,0,1,1,
6:      *      1,3,1,1,1,2,2,0,4,0,0,1,1,4,4,1,0,3,2,2,
7:      *      2,3,0,3,1,3,3,1,4,1,0,0,2,3,2,3,4,3,4,2/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 9...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FL9
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.D.C 11

```
1:      SUBROUTINE ELKAC
2:      DIMENSION ISTM(100),XRT(100)
3:      DATA ISTM/3,1,4,2,3,4,4,4,1,0,0,2,0,3,0,2,0,2,1,3,
4:      *      0,0,3,1,1,0,4,4,0,1,2,2,4,2,3,0,0,3,0,4,
5:      *      3,1,2,4,0,3,4,4,2,0,2,1,3,1,1,3,0,3,1,1,
6:      *      0,4,4,2,0,2,3,4,4,1,0,2,0,4,4,4,2,2,2,3,
7:      *      3,2,3,2,1,3,1,4,1,4,1,3,2,1,3,0,3,2,1,1/
8:      WRITE(2,1000)
9: 1000  FORMAT('BLOCK 10...READY ?')
10:     CALL BLK0C(ISTM,XRT)
11:     CALL FLA
12:     REWIND 8
13:     WRITE(8)ISTM,XRT
14:     RETURN
15:     END
```

SRT.D.C 12

```
1:      SUBROUTINE ELKOC(ISTM,XRT)
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      READ(1,1001)A
6: 1001  FORMAT(A4)
7: 100   CALL INP40(IRES)
8:      IF(IRES.EQ.0)GO TO 100
9:      CALL INTLTM
10: 101   CALL TMR(110MS,ISEC)
11:      IF(110MS.LT.50)GO TO 101
12:      CALL OUT40(128)
13: 102   CALL INP41(IRES)
14:      IF(IRES.EQ.0)GO TO 102
15:      CALL OUT40(0)
16:      DO 110 I1=1,2
17:      CALL INTLTM
18: 111   CALL TMR(110MS,ISEC)
19:      IF(ISEC.LT.2)GO TO 111
20:      CALL OUT40(128)
21: 112   CALL INP41(IRES)
22:      IF(IRES.EQ.0)GO TO 112
23:      CALL OUT40(0)
24: 110   CONTINUE
25:      DO 200 I2=1,100
26:      CALL INTLTM
27:      I21=ISTM(I2)
28:      ITI=100
29: 201   IF(I21.EQ.0)GO TO 211
30:      ITI=IFIX(FLOAT(ITI)*1.3)
31:      I21=I21-1
32:      GO TO 201
33: 211   CALL TMR(110MS,ISEC)
34:      IF(110MS.LT.111)GO TO 211
35:      CALL OUT40(128)
36:      CALL INTLTM
37: 212   CALL INP41(IRES)
38:      CALL TMR(110MS,ISEC)
39:      IF(IRES.EQ.0)GO TO 212
40:      CALL OUT40(0)
41:      XRT(I2)=FLOAT(110MS)/100.0
42: 200   CONTINUE
43:      CALL OWARI
44:      RETURN
45:      END
```

SRT.D.C 13

```
1:      SUBROUTINE BLK0D(ISTM,XRT)
2:  C
3:      DIMENSION ISTM(100),XRT(100)
4:  C
5:      READ(1,1001)A
6: 1001  FORMAT(A4)
7:      DO 110 I1=1,2
8:          CALL BUZZER
9:          CALL INTLTM
10: 111   CALL TMR(110MS,1SEC)
11:      IF(1SEC.LT.2)GO TO 111
12:      CALL OUT40(128)
13: 112   CALL INP41(IRES)
14:      IF(IRES.EQ.0)GO TO 112
15:      CALL OUT40(0)
16: 110   CONTINUE
17:      DO 200 I2=1,100
18:          CALL BUZZER
19:          CALL INTLTM
20:          I21=ISTM(I2)
21:          ITI=100
22: 201   IF(I21.EQ.0)GO TO 211
23:          ITI=IFIX(FLOAT(ITI)*1.3)
24:          I21=I21-1
25:          GO TO 201
26: 211   CALL TMR(110MS,1SEC)
27:          IF(110MS.LT.ITI)GO TO 211
28:          CALL OUT40(128)
29:          CALL INTLTM
30: 212   CALL INP41(IRES)
31:          CALL TMR(110MS,1SEC)
32:          IF(IRES.EQ.0)GO TO 212
33:          CALL OUT40(0)
34:          XRT(I2)=FLOAT(110MS)/100.0
35: 200   CONTINUE
36:      CALL OWARI
37:      RETURN
38:      END
```

SRT.D.C 14

```
1:      SUBROUTINE BUZZER
2:      CALL INTLTM
3: 300    CALL TMR(110MS,1SEC)
4:      CALL INP40(IRES)
5:      IF(IRES.NE.0)GO TO 400
6:      IF(110MS.LT.50)GO TO 300
7:      CALL INTLTM
8:      CALL OUT41(128)
9: 100    CALL TMR(110MS,1SEC)
10:     CALL INP40(IRES)
11:     IF(IRES.NE.0)GO TO 400
12:     IF(110MS.LT.20)GO TO 100
13: 420    CALL OUT41(0)
14:     CALL INTLTM
15: 500    CALL TMR(110MS,1SEC)
16:     CALL INP40(IRES)
17:     IF(IRES.NE.0)GO TO 400
18:     IF(110MS.LT.10)GO TO 500
19: 200    CALL INP40(IRES)
20:     IF(IRES.EQ.0)GO TO 200
21:     RETURN
22: C
23: 400    CALL INP40(IRES)
24:     CALL OUT41(128)
25:     IF(IRES.NE.0)GO TO 400
26:     CALL INTLTM
27: 410    CALL TMR(110MS,1SEC)
28:     IF(1SEC.LT.5)GO TO 410
29:     GO TO 420
30: C
31:      END
```

SRT.D.C 15

```
1:      SUBROUTINE DTANL1
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL1
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 1'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 16

```
1:      SUBROUTINE DTANL2
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL2
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 2'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 17

```
1:      SUBROUTINE DTANL3
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL3
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 3'///
10:      *      IX,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 18

```
1:      SUBROUTINE DTANL4
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL4
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 4'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 19

```
1:      SUBROUTINE DTANL5
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL5
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 5'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 20

```
1:      SUBROUTINE DTANL6
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL6
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 6'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 21

```
1:      SUBROUTINE DTANL7
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL7
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 7'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 22

```
1:      SUBROUTINE DTANL8
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL8
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 8'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 23

```
1:      SUBROUTINE DTANL9
2: C
3:      DIMENSION ISTM(100),XRT(100)
4: C
5:      CALL FL9
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 9'///
10:      *      1X,5('ITI RT(SEC) '),//)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```


SRT.D.C 24

```
1:      SUBROUTINE  DTANLA
2: C
3:      DIMENSION  ISTM(100),XRT(100)
4: C
5:      CALL FLA
6:      REWIND 8
7:      READ(8)ISTM,XRT
8:      WRITE(6,1000)
9: 1000  FORMAT(1H1,10X,'DATA OF BLOCK 10'///
10:      *      1X,5('ITI  RT(SEC)  '),///)
11:      CALL DTANL0(ISTM,XRT)
12:      RETURN
13:      END
```

SRT.D.C 25

```
1:      SUBROUTINE DTANL0(I STM,XRT)
2:  C
3:      DIMENSION I STM(100),XRT(100),XITI(5),XTBL(5,5,10),
4:      *          JTBL(5,5),XSTM(5),XXRT(5)
5:  C
6:      DO 100 I1=1,20
7:      DO 110 I11=1,5
8:      J1=(I1-1)*5+I11
9:      XXRT(I11)=XRT(J1)
10:     KSTM=100
11:     KSTP=I STM(J1)
12: 112 IF(KSTP.EQ.0)GO TO 111
13:     KSTM=IFIX(FLOAT(KSTM)*1.3)
14:     KSTP=KSTP-1
15:     GO TO 112
16: 111 XSTM(I11)=FLOAT(KSTM)/100.0
17: 110 CONTINUE
18:     WRITE(6,1100)(XSTM(J1),XXRT(J1),J1=1,5)
19: 1100 FORMAT(IX,5(F5.2,F6.2,3X))
20: 100 CONTINUE
21:  C
22:  C
23:     DO 200 I2=1,5
24:     DO 201 I21=1,5
25:     DO 202 I22=1,10
26:     XTBL(I2,I21,I22)=99999.9
27: 202 CONTINUE
28:     JTBL(I2,I21)=0
29: 201 CONTINUE
30: 200 CONTINUE
31:     K2=I STM(1)+1
32:     DO 210 I2=2,100
33:     K1=K2
34:     K2=I STM(I2)+1
35:     JTBL(K1,K2)=JTBL(K1,K2)+1
36:     K3=JTBL(K1,K2)
37:     XTBL(K1,K2,K3)=XRT(I2)
38: 210 CONTINUE
39:     KITI=100
40:     DO 300 I3=1,5
41:     XITI(I3)=FLOAT(KITI)/100.0
42:     KITI=IFIX(FLOAT(KITI)*1.3)
43: 300 CONTINUE
44:     WRITE(6,2000)
45: 2000 FORMAT(1H1,5X,'CONTINGENCY TABLES')
46:     DO 400 I4=1,5
47:     WRITE(6,2100)XITI(I4),(XITI(J4),J4=1,5)
48: 2100 FORMAT(///15X,'RT''S FOR',F5.2,IX,'SEC. FP'//
49:      *          12X,'CONTINGENT ON PREVIUOS FP''S.'//
50:      *          10X,5(F5.2,' SEC.')//)
51:     WRITE(6,2200)((XTBL(JK1,I4,JK2),JK1=1,5),JK2=1,10)
52: 2200 FORMAT(10(10X,5(F5.2,5X),/))
53: 400 CONTINUE
```

SRT.D.C 25

54: C

55: C

56: RETURN

57: END

APPENDIX E

The program for calculating the values in
Figures 6 and 7.

L

```

00010 C
00020 C      MAIN PROGRAMM
00030 C
00040      WRITE(6,1000)
00050 1000  FORMAT(1X,'MIN T =')
00060      READ(5,1010)XMINT
00070 1010  FORMAT(F7.2)
00080      WRITE(6,1020)
00090 1020  FORMAT(1X,'MAX T =')
00100      READ(5,1010) XMAXT
00110      WRITE(6,1030)
00120 1030  FORMAT(1X,'ROU =')
00130      READ(5,1010)ROU
00140      WRITE(6,1040)
00150 1040  FORMAT(1X,'LAMDA =')
00160      READ(5,1010)XLAMD
00170      WRITE(6,1050)
00180 1050  FORMAT(1X,'DELTA =')
00190      READ(5,1010)DELT
00200      WRITE(6,1070)
00210 1070  FORMAT(1X,'MEAN RT IN THE NOT READY STATE =')
00220      READ(5,1010)RTNR
00230      WRITE(6,1080)
00240 1080  FORMAT(1X,'MEAN RT IN THE READY STATE =')
00250      READ(5,1010)RTR
00260      WRITE(6,3000)
00270 3000  FORMAT(1X,'BACKGROUND WEIGHT =')
00280      READ(5,1010)WB
00290      WRITE(6,3010)
00300 3010  FORMAT(1X,'PREV. ST. WEIGHT =')
00310      READ(5,1010)WPR
00320      WRITE(6,3020)
00330 3020  FORMAT(1X,'BACKGROUND SET UP TIME =')
00340      READ(5,1010)TB
00350      WRITE(6,2030)
00360 2030  FORMAT(1X,'PREV. T =')
00370      READ(5,1010)TPR
00380      READ(5,1060)A
00390 1060  FORMAT(A4)
00400 C
00410 C
00420      WRITE(6,2000)XMINT,XMAXT,ROU,XLAMD,DELT,RTNR,RTR,
00430      *      WB,WPR,TB,TPR
00440 2000  FORMAT(5X,'MINIMUM VALUE OF T =',F7.2//
00450      *      5X,'MAXIMUM VALUE OF T =',F7.2//
00460      *      5X,'ROU =',F7.2//
00470      *      5X,'LAMDA =',F7.2//
00480      *      5X,'DELTA =',F7.2//
00490      *      5X,'MEAN RT IN THE NOT READY STATE =',F7.2//
00500      *      5X,'MEAN RT IN THE READY STATE =',F7.2//
00510      *      5X,'WEIGHT OF BACKGROUND =',F7.2//
00520      *      5X,'WEIGHT OF THE PREVIOUS STIMULUS =',F7.2//
00530      *      5X,'BACKGROUND SET UP TIME =',F7.2//
00540      *      5X,'PREVIOUS T =',F7.2//)
00550 C
00560 C      *****      DELT MODIFIED      *****
00570 C
00580      T0=(WB*TB+WPR*TPR)/(WB+WPR)
00590      DELT=DELT*T0
00600      WRITE(6,4000)DELT
00610 4000  FORMAT(5X,'MODIFIED DELTA = ',G12.5//
00620      *      //5X,'T =',17X,'P =',17X,'MEAN RT =')
00630      T=XMINT
00640 200  IF(T.GT.XMAXT)GO TO 100
00650      XP=P(T-T0,ROU,XLAMD,DELT)

```

```

00660      RT=XP*RTR+(1.0-XP)*RTHR
00670      WRITE(6,2010)T,XP,RT
00680 2010  FORMAT(5X,G12.5,8X,G12.5,8X,G12.5)
00690      T=T+0.1
00700      GO TO 200
00710 C
00720 C
00730 100  WRITE(6,2020)
00740 2020  FORMAT(/5X,'NORMAL END')
00750      STOP
00760      END
00770 C
00780 C
00790 C
00800 C          ***** SUBROUTINE *****
00810 C
00820      FUNCTION P(T,ROU,XLAMD,DELT)
00830      P=0.0
00840      DT=0.0
00850 300  IF(DT.GT.T)GO TO 200
00860      P=P+G(T-DT,ROU,XLAMD)*H(DT,DELT)*0.0001
00870      DT=DT+0.0001
00880      GO TO 300
00890 C
00900 200  RETURN
00910      END
00920 C
00930 C
00940 C          ***** SUBROUTINE *****
00950 C
00960      FUNCTION H(T,DELT)
00970      IF(T.LE.0.0)GO TO 100
00980      IF(T.LT.DELT)GO TO 200
00990      H=0.0
01000      RETURN
01010 C
01020 100  H=0.0
01030      RETURN
01040 C
01050 200  H=1.0/DELT
01060      RETURN
01070 C
01080      END
01090 C
01100 C
01110 C          ***** SUBROUTINE *****
01120 C
01130      FUNCTION G(T,ROU,XLAMD)
01140      IF(T.LE.ROU)GO TO 100
01150      IF(T.LT.(ROU+XLAMD))GO TO 200
01160      G=0.0
01170      RETURN
01180 C
01190 100  G=1.0
01200      RETURN
01210 C
01220 200  G=(ROU+XLAMD-T)/XLAMD
01230      RETURN
01240 C
01250      END
      KEQ52500I END OF DATA SET
      E

```

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